A Brief Appetite Awareness Intervention for Eating and Weight Regulation Among College Freshmen: A Randomized Clinical Trial

A Plan B Research Project
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Lauren E. Vieaux

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Dr. Lara LaCaille, Ph.D., Chair
Dr. Rick LaCaille, Ph.D.
Dr. Rebecca Gilbertson, Ph.D.
Dr. Charles Fountaine, Ph.D.

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Abstract

The pervasiveness of obesity within our society has become a leading public health concern. Weight loss interventions are largely ineffective over the long run, thus researchers are turning their efforts toward weight gain prevention approaches. Given that the time of greatest change in dietary quality and incidence of obesity is during young adulthood, it would seem that prevention approaches would ideally target this population. Currently, most prevention programs utilize informational approaches (i.e., providing nutrition education) and/or are time intensive. Although these approaches show small short-term effects, Appetite Awareness Training (AAT), delivered in a brief group format, may offer a low-cost intervention aimed at sustainable skills. With an emphasis placed on an individual's ability to eat intuitively based on bodily hunger and satiety cues, AAT transforms an individual's approach to eating, instilling long lasting awareness of one's eating habits. This study evaluated the efficacy of a brief AAT intervention versus a standard nutrition information intervention (NE) versus a no-treatment control. Freshman women (n=34) were randomly assigned to one of the three groups. Changes in weight, BMI, eating self-regulation, and other psychosocial variables were assessed at baseline, post-intervention, and 18 weeks post-intervention. Preliminary results show brief interventions (AAT and NE) to supersede no intervention with regards to ability to prevent unintended weight gain. Further, AAT participants showed greater confidence in efficaciously managing their weight and refraining from eating due to external influences.

Keywords: Obesity--Prevention, First year college students, Females

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Introduction

Rates of obesity and unhealthy approaches to weight loss continue to rise in our population and significantly impact our society at large (Ogden, Carroll, Kit, & Flegal, 2014). Recent data show that 34.9% or 78.6 million of U.S. adults are obese, with the rates steadily increasing among some segments of the population (Fryar, Carroll, & Ogden, 2014; Ogden et al., 2014). Not only do unhealthy eating and weight management habits impact the individual, but the issue also becomes increasingly costly to the general population, considering medical complications and healthcare expenses (Bean, Stewart, & Olbrisch, 2008). Obesity in the United States is estimated to cost $147 billion annually as of 2008, with the average medical costs for an obese person amounting to $1,429 more than a person of a healthy weight (Finkelstein, Trogdon, Cohen, & Dietz, 2009).

Research has also shown that young adulthood is the period of greatest risk for individuals to adopt unhealthy habits that lead to obesity. For example, first year college students are less likely to engage in physical activity during their freshman year, and show a decrease in healthy eating, potentially related to their newfound food choice independence (Smith-Jackson & Reel, 2012; Ullrich-French, Cox, & Bumpus, 2013). It may be that the change students experience when transitioning to a college environment acts as a significant stressor in their lives, leading to these unhealthy behaviors; however, this may also create an opportunity for a greater amount of positive change and motivation to increase one's healthy behaviors (Kasparek, Corwin, Valois, Sargent, & Morris, 2008; Mihalopoulos, Auinger, & Klein, 2008; Webb & Hardin, 2012).

Targeting Female College Students

Indeed, weight gain among college freshmen averages 4 lbs in their first year of college (Vella-Zarb & Elgar, 2009), with 50-80% gaining 5-10 lbs or more (Economos, Hildebrandt, & Hyatt, 2008; Edmonds et al., 2008; Gropper, Simmons, Connell, & Ulrich, 2012; Lloyd-Richardson, Bailey, Fava, & Wing, 2009). Therefore, this population is of key importance in targeting weight gain prevention strategies (Webb & Hardin, 2012). According to a recent review (Laska, Pelletier, Larson, & Story, 2012), only 10 published studies have assessed the effects of weight gain prevention programs on BMI change in college students; since the review, three additional studies have been identified (Lam, Partridge, & Allman-Farinelli, 2016). Although most show small positive effects, the interventions tend to be information-only based (e.g., a college nutrition course; n = 6) and/or high intensity (e.g., 1-3 hours weekly for 10+ weeks, n = 7). Such approaches seem difficult to sustain, either in terms of delivery costs and/or behavioral change. Additionally, few of these studies assessed mechanisms of change other than dietary intake and physical activity. Thus, there is an urgent call to understand and improve weight gain prevention strategies for young adults (Laska et al., 2012).

Among young adults, disordered eating habits are also widely prevalent; studies have shown that between 4-9% of college women meet the clinical diagnosis of an eating disorder, and 34-67% show subclinical symptomology (Berg, Frazier, & Sherr, 2009; Cooley & Toray, 2001; Fitzsimmons-Craft, Harney, Brownstone, Higgins, & Bardone-Cone, 2012). As many as 81% of U.S. college women report a desire to lose weight, with 11% attempting to control their weight through fasting and 4.3% through purging behaviors (Heron, Scott, Sliwinski, & Smyth, 2014; Keel, Heatherton, Dorer, Joiner, &

Zalta, 2006). In a recent study of freshmen women, individuals reported intense fears of gaining weight, but many also believed that this weight gain was inevitable (Smith-Jackson & Reel, 2012). Several interventions have previously targeted such eating disorder behaviors, but few researchers have studied interventions focused on obesity prevention.

The high prevalence of eating disorder symptoms and rates of obesity signify the value of including this population in preventative and intervention research. Both interventions and preventative measures could curtail the current patterns of weight concern and unhealthy eating behaviors in this population. Because college populations are more at risk of both weight gain and eating disorders, viewing both issues on a spectrum of the presentation of weight concern promotes a transdiagnostic model encouraging research to focus on common risk factors (Fairburn, Cooper, & Shafran, 2003).

Theories of Eating Behaviors

There are currently three prominent and accepted theories describing the link between non-physiologically based eating behaviors and obesity. Engaging in eating behaviors for reasons other than physiological hunger or continuing to eat past the point of satiety often leads individuals to increase energy intake past physical bodily needs; over time, the pattern of continuous eating in responses to cues other than physiological hunger may increase an individual's risk for obesity (Schembre, 2011). Understanding and addressing the key psychological and behavioral mechanisms that contribute to weight gain is important when considering intervention and prevention strategies.

Psychosomatic Theory. The psychosomatic theory posits that obesity results

from a link between negative emotion and eating. Individuals often respond to emotional or stressful situations in a way that will help them cope with the situation and bring comfort. Proposed by Bruch (1961, 1964), studies of the psychosomatic theory showed that many individuals sought comfort in food, and the utilization of food as means of comfort for negative or stressful situations became problematic as the frequency of such situations increased. Additional longitudinal studies conducted with adult women and female college students have assessed the connection between emotional eating and weight gain, showing a direct association (Hays & Roberts, 2008). Researchers now believe that an individual's vulnerability to emotional eating may be associated with neurobiological mechanisms associated with emotional responses (Schembre, 2011). Women often show higher emotional reactivity compared to men and tend to utilize emotional or avoidance coping mechanisms in response to stress, such as those seen in emotional eating (Matud, 2004). Additionally, it has been shown that foods with greater caloric density (e.g., sweet or fatty foods) are often expected to bring a greater sense of pleasure when being consumed (Keskitalo et al., 2008). When emotional eating episodes directed at providing comfort include calorically dense foods, excessive consumption may contribute to the course of obesity. Given the support for this theory, intervention strategies that address regulating emotional eating seem warranted in the prevention of weight gain, especially with women.

Theory of Externality. The theory of externality (Bruch, 1964) relates to the social aspect of eating behaviors and states that individuals are likely to eat as a result of external or environmental cues regardless of their physical hunger or satiety signals. It was originally proposed that individuals struggling with obesity were less able to discern

between physiological and cognitive desires to eat, when compared to their normal-weight counterparts; however, additional research has shown that normal-weight individuals may be just as likely to eat in response to external cues (Herman & Polivy, 2008). Wansink (2004) suggests that an individual's eating behavior is likely to change based on the cues of their external environment. Individuals may determine how much they are going to eat based on the size of a dinner assortment or the amount of food a dinner companion is eating, rather than eating in response to physiological hunger cues and stopping once they have reached satiety. Especially in social contexts where food is abundantly available, this may lead to overeating as eating behaviors are prompted by accessibility and the social interactions surrounding the behavior, rather than one's internal bodily cues (Wansink, 2012). Extensive data supporting the link between environmental cues and overeating suggests that obesity intervention and prevention efforts would do well to address the externality of eating behavior and teach strategies to reduce reliance on such cues.

Theory of Restraint. The theory of restraint (Herman & Mack, 1975) suggests that overeating is a direct result of restrictive dieting. Individuals who consistently diet are highly susceptible to external cues encouraging eating behaviors, and are likely to engage in periods of overeating, and thus weight regain. According to the "boundary model" of restrained eating, excessive dieting can result in physiological, social, and psychological changes that affect an individual's ability to detect hunger and satiety cues. The zone of indifference (i.e., the state in which an individual is not hungry or satiated) becomes larger in restrained eaters, or chronic dieters, because of their self-imposed training of individual hunger and satiety cues (Booth, 1988), thereby changing the

boundaries that guide the initiation of eating. Restrained eaters rely less on their physiological hunger and satiety cues, and more on personal beliefs or rules about food, such as those concerning the caloric content. Once a food rule is violated (e.g., ate a bite of a "forbidden food"), there is a tendency to overeat, as control is perceived as lost. This experience is often referred to as the abstinence violation effect (or "what the heck"). Previous research has shown a positive relationship between restricted eating and BMI, such that those who show greater restrained eating behaviors (such as skipping breakfast) are more likely to have a higher BMI (Snoek, Van Strien, Janssens, & Engels, 2007). A study by Ouwehand and Papies (2010) revealed that restrained eaters who are overweight may struggle to follow dieting guidelines and goals when confronted with attractive food, thus influencing their internal cues and enhancing their risk of overeating. Many interventions for eating disorders and obesity emphasize the importance of reducing rigid food rules and engaging in more flexible forms of restraint.

Intuitive Eating & Self-Regulation Interventions

The prevalence and consequences of maladaptive weight control behaviors among young women specifically indicates a need for intervention and treatment approaches designed to curb or prevent such behaviors. One approach includes raising an individual's awareness to one's body signals, making eating behaviors a reaction to hunger. Intuitive eating is characterized by responsiveness to an individual's physiological signals associated with hunger and satiety, rather than situational or emotional cues (Tylka, 2006). Research has shown a greater prominence of intuitive eating in males (Denny, Loth, Eisenberg, & Neumark-Sztainer, 2013) and a negative correlation with eating disorder pathology, particularly related to binge eating behaviors

and obesity (Tylka & Wilcox, 2006).

Often, individuals engaging in restrictive or binge eating behaviors have reduced sensitivity to detect their internal bodily hunger and fullness cues, and thus lack appropriate appetite awareness (Allen & Craighead, 1999). This awareness, or the ability to recognize physiological cues, is often referred to as interoceptive awareness, and has been shown to be lower in individuals with eating disorders (Jacobi, Hayward, de Zwaan, Kraemer, & Agras, 2004) and the absence of this awareness is thought to contribute to obesity (Brown, Smith, & Craighead, 2010). Wolever and Best (2009) proposed that eating disorders are, on a foundational level, related to disturbances in physiological self-regulation; this dysregulation may arise in individuals avoiding aversive or stressful experiences through severe caloric restriction, binge eating, and/or compensatory behaviors, such as purging. Indeed, several studies have shown that women who engage in binge eating exhibit an inconsistency or decreased response to physiological signals of satiety (Hadigan, Walsh, Devlin, LaChaussee, & Kissileff, 1992; Heilbrun & Worobow, 1991; Turner et al., 1991).

To reduce this dysregulation, individuals may need to become more physiologically aware and learn to decrease their emotional or externally based eating behaviors as a response to stressful situations. Training individuals to increase their awareness, then, may result in reduced eating disorder symptomology and behaviors that contribute to weight gain. Because most research on dysregulation has been conducted with eating disordered samples, it is unknown whether or not non-eating disordered individuals show the same dysregulation as those with eating disorders.

Appetite Awareness Training

Through Appetite Awareness Training (AAT; Craighead & Allen, 1995; Craighead, 2006) individuals are taught to become more aware of bodily sensations indicating hunger or fullness, and eat in response to these internal, rather than external, cues known to drive much of one's eating behavior. AAT addresses and specifically targets the behaviors that have been theorized to contribute to maladaptive eating habits, such as an individual's use of emotional eating, reliance or utilization of external cues, and addresses the impact of restraint on an individual's ability to respond naturally to her internal physiological cues often leading to both eating disorders and weight gain. First and foremost, it suggests that such problems result from an individual's detachment from or decision to override internal satiety cues. AAT was initially designed as a treatment intervention for individuals with bulimia and binge eating disorder (or problematic binge eating), as it aims to improve an individual's ability to self-regulate his/her eating practices.

The goal of AAT focuses on increasing an individual's ability to recognize and respond to internal physiological cues of hunger and satiety, as well as to reduce overeating (and binge eating) in response to emotional stimuli and replace this habit with more adaptive, problem-solving focused skills. AAT identifies the ability to eat in response to internal cues as "normal eating," and it is intended to replace problematic eating behaviors such as restriction, overeating, and binge eating (Craighead & Allen, 1995; See Figure 1). In an effort to decrease an individual's preoccupation with food, AAT focuses on use of internal physiological cues to guide food consumption rather than prescribing specific types of food individuals should eat. It is theorized that the

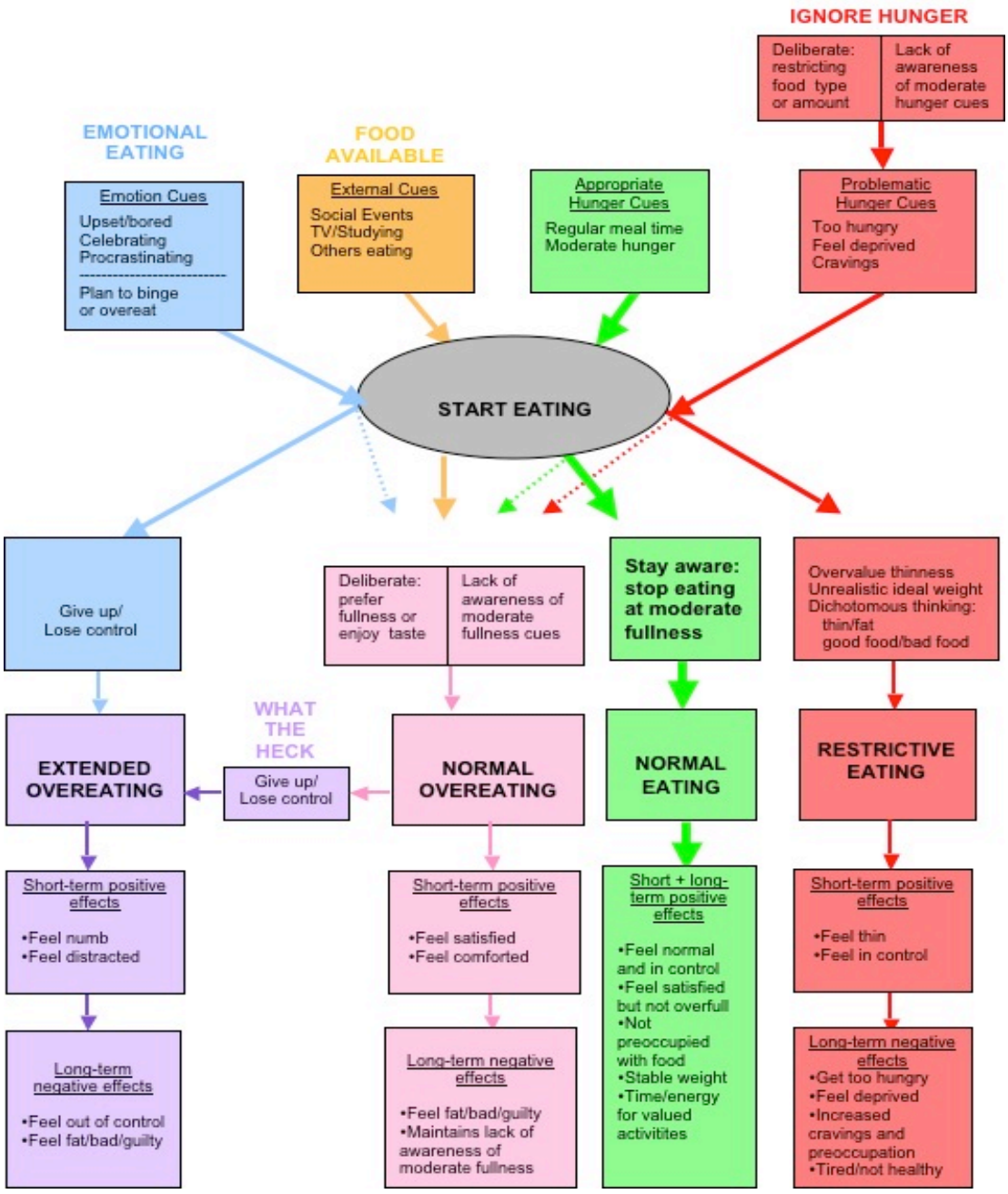


Figure 1. The Appetite Awareness Model for Overeating (Craighead, 2006). Reprinted with permission from author.

application of AAT may be associated with long-term maintenance of increased physiological awareness, as the foundation of AAT is based on increasing an individual's innate interoceptive awareness (Craighead & Allen, 1995). That is, the inherent nature of

internal awareness may create greater and more sustained treatment effects. Previous research has shown that AAT is effective in reducing restrictive and binge eating in individuals with eating disorders (Allen & Craighead, 2009; Craighead & Allen, 1995).

AAT as a Preventative Intervention

To date, two studies have examined the use of AAT as an intervention for the prevention of eating disorders and/or weight gain (Buckner, 2007; Smith, 2007). Buckner (2007) first assessed the effects of AAT in individuals at risk of developing an eating disorder. Participants who received the AAT intervention (n = 19) were involved in three weekly, individual sessions; the sessions followed instruction from the AAT manual detailing aspects of mindful eating and increased awareness to hunger and fullness cues. Participants were asked to monitor their appetite and reviewed their logs during their individual sessions. At a 1-month follow up, those participants in the AAT intervention showed lower levels of eating disorder pathology (e.g., decreased purging and bulimic behaviors) and dietary restraint compared to a no-treatment control group (Buckner, 2007). Limitations of this intervention include the time-intensive nature of conducting individual sessions, small sample, and generalizability to individuals without subclinical eating disorders.

In a follow up, Smith (2007) incorporated AAT into a weight gain prevention program for college women. Participants in the intervention condition (n = 32) attended five weekly group sessions focusing on encouraging healthy eating, increasing physical activity, and seeking social support for healthy behaviors. The intervention resulted in increased levels of appetite awareness and eating-related self-efficacy (i.e., self-control) in study participants, but did not affect participants' BMI or emotional awareness (Smith,

2007). The focus on multiple behaviors (e.g., eating, physical activity, and increased social support) prevents the outcomes of this study to be attributed solely to the AAT intervention, emphasizing the need to isolate the effects of AAT. Other limitations in this intervention include the small sample size, lack of an active control group, limited follow-up assessment results as the control group was offered post-test treatment, and the exclusion of measurements relating to individual's thin-ideal and body dissatisfaction.

Anecdotal evidence of providing a 1-session AAT to undergraduates in a seminar-type class suggests that the vast majority of individuals find this to be a novel and helpful approach to eating regulation that is relatively easy to adopt (LaCaille, personal communication); however, this has not been formally assessed in isolation of physical activity and adjunctive nutritional counseling. In addition, the absence of an active comparison group in previous research limits the ability of AAT intervention results to be attributed solely to the skills learned in AAT, rather than simply to participation in an active treatment group. It is important to compare AAT to other interventions to assess the feasibility, effectiveness, generalizability, and sustainability of AAT skills over time. It seems likely that AAT, delivered to non-eating disordered individuals, has the potential to teach self-regulation skills that will be helpful life long, and can be useful in healthy weight management and may spill over to other behaviors (e.g., drinking, studying).

Aims and Hypotheses

The current study looked to add to the limited body of research examining AAT as a preventative intervention for weight gain and dysregulated eating behaviors. It addressed prior limitations in the research by adding a nutritional education treatment condition (i.e., standard approaches to weight gain prevention). Through the separation of

nutritional counseling and the AAT intervention into two active treatment conditions, outcomes in the conditions can be related to the type of intervention, rather than involvement in an active (versus inactive) group. In addition, by eliminating the physical activity component in the AAT intervention group, changes in self-regulatory eating habits can be attributed to the awareness and response to the participants' physiological hunger and satiety cues. The use of a group format will support the effectiveness of this intervention in targeting many people in brief intervals. Many intervention studies for the treatment of eating disorders (particularly binge eating disorder and bulimia nervosa) and obesity have targeted the mechanisms thought to contribute to these problems, including a reduction of emotional eating, eating in response to environmental cues, and regulating eating patterns (i.e., avoiding meal skipping). However, these intervention strategies have rarely been applied to prevention programs.

It was hypothesized that:

1. Individuals receiving the AAT intervention would increase their levels of appetite awareness, intuitive eating and eating self-regulation, and decrease restrictive and binge-eating behaviors. The ability of these individuals to adapt AAT skills would increase healthy eating habits and prevent unintended weight gain.
2. We predicted that individuals in the AAT intervention would respond with greater change related to intuitive eating abilities, self-regulatory eating processes, and decreased restrictive and binge eating practices, compared to both the nutritional education and control conditions.

3. Individuals in both the AAT intervention group and nutritional education group were expected to maintain a relatively stable weight, with no indication of excessive or unintended weight gain

Although only data from the pre-post comparison is presented in this manuscript, we also expected that individuals in the AAT intervention group would surpass the nutritional education group in their ability to maintain these results at the 4-month follow-up.

Method

The CONSORT Guidelines (Consolidated Standards of Reporting Trials; Schulz, Altman, & Moher, 2010) have been followed when writing the final Plan B manuscript and reporting all study analyses. The guidelines will also be utilized for all subsequent manuscripts for publication. The materials used in this study have been approved by the Institutional Review Board (IRB) and registered with the governmental database as a clinical trial (NCT02496637).

Design & Intervention

This study used a 3x3 mixed factorial experimental design, randomly assigning participants to one of three conditions: 1) AAT, 2) a standard nutrition information comparison group, and 3) a no treatment control group. Participants completed pre- and post-treatment assessments, as well as a 4-month follow-up assessment. Through the use of both post-test and follow-up assessments, we were able to measure the initial impact of the intervention groups, as well as the ability of participants to maintain their learned skills over time, when the active treatment ceases.

The active interventions included three weekly group sessions each lasting 1 hour, with an hour-long follow-up booster session 1-month later (4 sessions total). The use of a

multisession intervention has shown to be more effective, as participants are able to glean new skills and information to a greater extent, as well as test such skills and problem solve their usage between sessions (Stice & Shaw, 2004).

Appetite Awareness Training. The AAT intervention was based on the manual developed by Dr. Linda Craighead (Craighead, 2006) to treat eating disorders, particularly bulimia and binge eating disorder. It is aimed at teaching individuals to recognize and respond to internal physiological cues of hunger and satiety, rather than emotional or external cues initiating eating behavior. The methods involved in the intervention were adapted to target non-eating disordered individuals for the purpose of this study. Several components of the manual were included in the intervention based, in part, on the make-up of our study population.

Participants were explained the rationale behind AAT and taught skills to incorporate increased awareness into their eating. Participants were introduced to AAT concepts such as "Food Available," "Emotional Eating," and "What the Heck" to guide their understanding of eating behaviors. During the time between sessions, participants completed a Record of Eating Episodes (REE; see Appendix A) each day and brought the completed records back to the next session; these records guided participants to engage in eating behaviors at appropriate times (e.g., when neither too hungry or too full) and record their experiences (i.e., a meal or snack, time of episode, level of physical hunger, cue to eat). During each session, participants discussed with the group leaders any problems or difficulties that occurred over the past week and engaged in problem solving and skill application to address these issues. An overview of the topics involved in each session is provided in Appendix B.

Nutrition Education Comparison Group. Participants in the nutrition counseling comparison group underwent similarly timed sessions facilitated by a dietician. These sessions introduced participants to general nutritional concepts such as types of nutrients and forms of energy, individualized caloric requirements and portion sizes, and meal planning in various settings to promote healthy eating. Content involved in the sessions was based primarily on governmental guidelines related to portions and recommended serving sizes. Participants kept food logs documenting the types of foods they consumed as well as the amounts of those foods. As in the AAT intervention, participants discussed with the group and dietician problems they ran into over the course of the week between sessions inhibiting their ability to carry out healthy eating or weight regulation skills learned in the sessions. An overview of topics discussed in the nutritional counseling comparison group is included in Appendix B.

Participants & Recruitment

Participants in this intervention include female, freshmen undergraduate students, who resided in the on-campus dormitories at the University of Minnesota Duluth, and expressed concern about potential weight gain. Research has shown an unequal distribution of weight concern between males and females when controlling for muscularity desire, with female college students having shown to be more concerned with their potential for weight gain in their first year (Cooley & Toray, 2001; Grossbard, Lee, Neighbors, & Larimer, 2009; Mihalopoulos, Auinger, & Klein, 2008). As gender acts as a moderator in the presence and utilization of healthy weight management techniques, the use of an all-female participant pool allowed us to reduce error variance in our design.

All female freshmen students residing in the dorms (n = 686) received a recruitment email (see Appendix C). Inclusionary criteria for this study entailed freshmen women between the ages of 18-20, living in campus dormitories. Current or past history of an eating disorder was not an exclusionary criterion. Because the AAT intervention was initially created as a treatment for bulimia nervosa and binge eating disorder, we were not concerned about increasing eating disorder symptomology and such individuals had the potential to improve. In fact, the previous administrations of AAT as a weight gain prevention intervention showed decreased symptomology in those individuals initially meeting full or partial criteria for an eating disorder (Brown, Smith, & Craighead, 2010; Buckner, 2007). In the present study, if such participants were identified during the baseline assessment process, they were advised by the principal investigator during the informed consent procedure that this program is not intended to treat clinical eating disorders, and were given referral information to seek appropriate treatment for their symptoms. If the individuals chose to proceed, they were randomized to one of the conditions.

Procedure

Participants were initially contacted via email during a mandatory welcome week prior to the start of the semester to assess interest and eligibility. The email offered a brief overview of the study, indicating its purpose as increasing healthy eating behaviors leading to the prevention of unintentional weight gain. Interested individuals were asked to follow a link to complete a brief online screening questionnaire that inquired about 1) eligibility criteria, 2) self-reported height and weight, 3) current dormitory name and

floor, 4) availability for participation in all four sessions and 5) level of interest and commitment to participation in the study.

Eligible and interested participants were then sent a link to the baseline questionnaires that were completed online via Qualitrics Survey Software. Participants were asked to agree to the consent for randomization/treatment and sign up for a time to complete the anthropometric measurements. Upon arrival, the primary investigator (PI) met with each individual to review the consent form, to ensure that the participant understood what her involvement in the study entailed and to have her questions answered.

After giving consent, the participant was assigned to one of the three conditions and informed of her assignment. Participants were randomly assigned to one of the three conditions (n = 12, AAT; n = 10, NE; n = 12, NTC) with the exception of women living on the same floor of the same dormitory being randomly assigned by group. This was done to reduce the likelihood of contamination of the intervention, should floormates discuss the intervention with one another, which seemed a likely possibility.

Participants underwent the baseline anthropometric measurements (height, weight, % body fat) conducted by trained research assistants. The use of research assistants allowed those taking the measurements to be blind to condition while gathering the data.

Those in the AAT condition received guided administration of AAT over the course of three weekly group sessions, with an additional booster session three weeks after completion (week 6). The standard treatment comparison group received four similarly timed group sessions of psychoeducational/nutrition information facilitated by a

registered dietician. The faculty advisor and the primary researcher in this study acted as co-leaders in the AAT intervention groups; the faculty advisor is a licensed psychologist with a background in eating disorder and obesity research and treatment. A registered dietician, with experience in administering nutrition and wellness education groups, facilitated the nutritional information comparison group. A manualized approach to administration of the intervention was created based on the AAT treatment and was strictly followed in order to standardize the implementation of the prevention groups. The no-treatment control group only participated in the assessments.

At the end of the 4th session, participants were weighed and completed the post-treatment assessment. Laptops were provided to participants to complete the assessments immediately after the session. If participants could not complete the assessment immediately after the final session, they were instructed to complete the assessment on their own within a few days. Participants received their compensation in the form of a $15 gift card after they have completed the assessment. Participants also underwent an assessment at a 4-month follow up and received an additional $15 gift card after the assessment had been completed.

Measures

The battery of assessments included several validated, standardized measures and were completed at times baseline, post-treatment, and follow-up by each participant, with the exception of demographic information being asked only at baseline. For the full study questionnaire, see Appendix D.

Outcome Measures

Measures were selected or created to align with the primary outcomes being explored in this study. Each measure is associated with a pathway depicted in the AAT model assessing participants' levels of appetite awareness, levels of intuitive eating, restrictive or binge-eating patterns, and their perceived ability to efficaciously manage their eating and weight.

Anthropometric Measures. Participants' weight and height was documented as objective physical measurements, as well as percent body fat via bioelectrical impedance, assessed by the Tanita Body Composition Analyzer (model TBF-300A). While the measurement of body fat through this scale is less reliable than some measures (Fosbøl & Zerahn, 2015), it was selected because it is a low-cost, quick, and non-intrusive method of assessing participants' body fat. Participants' height was measured to the nearest tenth of a centimeter without shoes using a stadiometer portable (HM 200P Portstad), and weight was measured in light clothing at a consistent time of day. Body Mass Index (BMI; kg/m^2) was calculated for each participant.

Interoceptive Awareness Questionnaire-Expanded. The Interoceptive Awareness Questionnaire-Expanded (IAQ-E; Trenary, Craighead, & Hill, 2005) was created as an expansion to the Interoceptive Awareness subscale included on the Eating Disorders Inventory-2 (EDI-2, Garner, 1991). This 15-item self-report measure is utilized to assess levels of awareness regarding internal sensations of (1) Appetite (7 items), (2) Emotion (5 items), and (3) Restriction (3 items). High scores on this measure correlate with poorer interoceptive awareness (where 1 = never and 6 = always). In the present study, this measure showed high internal consistency (α = .90). The appetite subscale of the IAQ-E assesses an individual's ability to detect and follow appropriate hunger cues,

eat at regular meal times, and eat at moderate levels of hunger, all of which align with the desired normal eating pathway of the AAT model.

Intuitive Eating Scale - 2. Two subscales from the Intuitive Eating Scale (IES-2; Tylka & Kroon Van Diest, 2013) were used to measure participants' current levels of intuitiveness and impulsivity related to their eating habits. Fourteen items from two subscales were used to assess two primary components of intuitive eating related to (1) unconditional permission to eat, and (2) eating for physical rather than emotional reasons. This Likert scale associates higher scores (where 1 = strongly disagree and 5 = strongly agree) with greater endorsement of intuitive eating, which has been shown to negatively correlate with eating disorder symptomology (Tylka & Kroon Van Diest, 2013). The original IES has shown high levels of internal consistency across the three subscales (α = .72-.91) and 3-week test-retest reliability ranging from (r = .74-.88; Tylka & Wilcox, 2006). The IES-2 showed significant convergent validity with the IES, with correlations of the subscales ranging from .86 to .95. The test-retest reliability of the IES-2 was shown to be significant for both men and women (r = .77-.92; Tylka & Kroon Van Diest, 2013). In the current study, the IES-2 showed acceptable internal consistency on the two subscales (α = .69). It contributed to our understanding of participants' deliberate restricting of certain food types or amounts (restrictive pathway-AAT model), as well as assessing participants' tendency to eat for emotional reasons (e.g., when upset, bored, celebrating, procrastinating; emotional eating pathway-AAT model).

Mindful Eating Questionnaire. Five items from the disinhibition subscale of the Mindful Eating Questionnaire (MEQ; Framson et al., 2009) were used to assess participants' level of restraint in regards to self-regulatory eating behaviors. The measure

uses a Likert scale (1 = never/rarely and 4 = usually/often) and higher scores on this measure reflect greater disinhibition when eating. The disinhibition subscale has exhibited strong internal consistency (α = .83). The MEQ was used to test the influence of external cues, social events, distractions such as TV and/or studying, and the presence of others eating nearby on an individual's likelihood of engaging in overeating in certain contexts (food available pathway-AAT model).

Weight Efficacy Life-Style Questionnaire. The Weight Efficacy Life-Style Questionnaire (WELQ; Clark, Abrams, Niaura, Eaton, & Rossi, 1991) measures five facets of self-efficacy related to weight management including confidence in one's ability to resist eating when 1) food is highly available 2) experiencing negative emotions, 3) experiencing physical discomfort, 4) engaging in positive activities, or 5) experiencing social pressures to eat (subscale names underlined). This 20-item self-report measure uses a Likert scale (where 1 = not confident and 10 = very confident), with higher scores indicating greater self-control over eating behaviors (total scores can range from 0-180). This measure showed high reliability (α = .93), and has previously been shown to increase following treatment for binge eating disorder and obesity (Katterman, 2013; Wolff & Clark, 2001). In the current study the WELQ was used to test for individuals' ability to maintain self-control over eating behaviors across a variety of contexts (i.e., Emotional Eating, Food Available pathways-AAT model).

Eating Disorder Examination – Questionnaire. Seven items from the Eating Disorder Examination-Questionnaire (EDE-Q; Fairburn & Beglin, 1994) were used to assess individuals' engagement in binge eating behaviors. This questionnaire is a self-report format of the Eating Disorder Examination (EDE) clinical interview used to gauge

the extent to which individuals endorse binge-eating episodes, with and without a sense of lost control. In a review of the literature on the use of the EDE-Q with college, community, and clinical populations, it has shown acceptable 2-week test-retest reliability (r = .66-.94) and high internal consistency (α = .70-.93; Berg, Peterson, Frazier, & Crow, 2012). The EDE-Q was utilized to measure participants' specific eating disorder behaviors such as frequency of self-identified binge-eating episodes, which was indicated as a primary outcome, and engagement in compensatory behaviors (e.g., self-induced vomiting, compulsive exercising) which were used in the screener process to intervene with active eating disorder symptomology.

Secondary Measures

Additional measures were used to assess secondary outcomes in this study or were considered possible moderators. Although these variables were not specifically targeted in the intervention, they have been found in past research to be correlated with weight loss or weight gain prevention in other studies (Berscheid, Walster, & Bohrnstedt, 1973; Stice & Agras, 1998; Stice, Butryn, Rohde, Shaw, & Marti, 2013).

Body Dissatisfaction. A modified version of the Satisfaction and Dissatisfaction with Body Parts Scale (Berscheid, Walster, & Bohrnstedt, 1973) was used to assess participants' personal body dissatisfaction with nine specific body parts. This 10-item Likert scale (1 = extremely dissatisfied and 5 = extremely satisfied) showed significant internal consistency (α = .80). Previous research has found it to be reliable (2-week test-retest reliability r = .90), and sensitive to change following intervention for weight concern (Stice et al., 2013). As a secondary outcome measure, this scale tests participants' tendency to overvalue thinness, hold unrealistic ideal weight goals, and

employ dichotomous thinking (thin/fat, good food/bad food) presented in the restrictive eating pathway of the AAT model.

Thin-Ideal Internalization. The Ideal-Body Stereotype Scale-Revised (IBSS-R; Stice & Agras, 1998) is an 8-item measure that was used to assess the extent to which participants identified with the societal ideal equating thin body types with attractiveness. A 1-5 Likert scale was used where 1 = strongly disagree and 5 = strongly agree, with higher scores representing greater idealization of a thin body (i.e., overvaluing the importance of thinness). This scale had acceptable internal consistency (α = .85) and has shown significant convergent, discriminant, and predictive validity (Stice & Agras, 1998). This measure also demonstrates satisfactory 3-week test-retest reliability (r = .80; Stice, Shaw, Burton, & Wade, 2006). Similar to the body dissatisfaction scale, the IBSS-R contributes to the assessment of participants' engagement in overvaluing thinness, holding unrealistic ideal weight expectations or goals, and the likelihood they engage in dichotomous thinking shown in the restrictive eating pathway of the AAT model. This measure targets unrealistic thinking often associated with the restrictive pathway of eating in the AAT model and has been shown in previous research to be a secondary outcome in studies targeting freshman women with eating disordered behaviors.

The Positive and Negative Affect Scale. The Positive and Negative Affect Scale (PANAS; Watson, Clark, & Tellegen, 1988) includes two 10-item subscales (Positive Mood, Negative Mood) designed to assess an individual's mood over a specific period of time. Participants were presented with an emotion word and asked to what degree they have experienced that emotion in "the last few weeks." The PANAS showed adequate internal consistency (α = .74), and has previously been found to be reliable among

college student, adult, and psychiatric inpatient populations (8-week test-retest reliability r = .85-.91). The PANAS has also shown high convergent validity (r = .89-95).

Dieting and Weight History. The dieting and weight history items were used to assess participants' current dieting status, patterns or history of dieting, and weight suppression (i.e., the difference between participants' highest previous weight and current weight). Many of the items assessed in the dieting and weight history have been previously shown to be associated with weight gain prevention and effective weight management strategies (Wing et al., 2015). Behaviors such as consistently eating breakfast and weighing oneself regularly are likely to have an impact on the influence of the intervention and the individual's ability to manage their weight effectively.

Physical Activity and Sedentary Behavior. Current engagement in physical activity and sedentary behavior was assessed using select items from the International Physical Activity Questionnaire short-form (IPAQ; Craig et al., 2003) and the Godin Leisure Time Exercise Questionnaire (GLTEQ; Godin & Shepard, 1985). Two items from the IPAQ were used to assess participants' sedentary behavior; this measure has shown acceptable psychometrics and significant test-retest reliability (r = .80) with higher scores indicating greater sedentary behavior. The GLTEQ has shown significant reliability and validity across multiple studies and was used to assess participants' levels of physical activity (Godin & Shephard, 1985). The four items utilized from this measure assessed mild, moderate, and vigorous activity levels over the course of a one-week period with higher scores indicating more physical activity. The items from both the IPAQ and the Godin were selected based on a 2012 review as the best tools to assess physical activity levels and sedentary behavior in this population with the fewest number

of items, keeping the questionnaire concise but accurate (Helmerhorst, Brage, Besson, Ekelund, & Warren, 2012).

Other Health Habits. Participants were asked basic health habits questions to garner an overall understanding of their health history. These questions related to the health status of their current diet, smoking habits, current alcohol consumption, sleep patterns, and average consumption of fruits and vegetables. Many of these habits, particularly sleep and the consumption of alcohol, fruits, and vegetables, impact the overall health status of participants and influence their caloric intake. Such factors have previously been shown to serve as moderators of the weight related outcomes explored in this study (Lloyd-Richardson, Lucero, Dibello, Jacobson, & Wing, 2008).

Program Evaluation. Following the administration of the intervention, participants in the treatment conditions were asked to evaluate the impact and effectiveness of the program (see Appendix E). Questions included participants' overall satisfaction with the intervention, group leaders, and self-monitoring tasks, as well as their level of compliance and perceived efficacy of the intervention.

Treatment Fidelity. Intervention sessions were administered by trained members of the research team based on the manualized approach to Appetite Awareness Training (Craighead, 2006; AAT group) and governmental guidelines for healthy eating (NE group). In order to ensure intervention consistency across treatment sessions and groups, a trained graduate research assistant was present throughout each of the intervention sessions in all AAT and NE groups. The research assistant monitored outlines of each of the intervention sessions to verify that the topics covered in the sessions remained consistent and followed the treatment manuals.

Results

Enrollment and Retention

In total, three emails were sent to the 686 female freshmen living on campus over the course of a three-week period. Of these individuals, 76 completed the screening questionnaire and were sent the link to the consent from and baseline questionnaire. Forty-one women completed the pre-treatment assessment (baseline questionnaire and anthropometric measurements). Forty women were randomized to one of the three groups, while one woman did not respond to inquiry about her availability. Five randomized participants did not complete the study. Four of these participants chose not to participate; because they were not exposed to the treatment conditions, these participants were not considered drop-outs. One participant in the NE group attended one session prior to discontinuing participation due to time constraints, and therefore is considered a drop out. See Figure 2 for participant flow chart.

Participants

Participants ranged from 18-19 years of age with a mean age of 18.04 (*SD* = 0.21). This sample was 2% Asian or Pacific Islander, 7% Black, Non-Hispanic, 4% Native American, 85% White, and 2% self-identified as Other. Forty-one of the 46 women completed the pre-treatment assessment and anthropometric measures, with a mean weight of 65.40 kg (*SD* = 11.59), mean body fat percentage of 27.5% (*SD* = 7.58), and mean BMI of 23.97 (*SD* = 3.60).

The final participant sample used in the outcome analysis included 35 participants. Sample characteristics and health habits at baseline are reported in Table 1. Participants differed to a significant degree ($p = .01$) on the amount of vegetables they

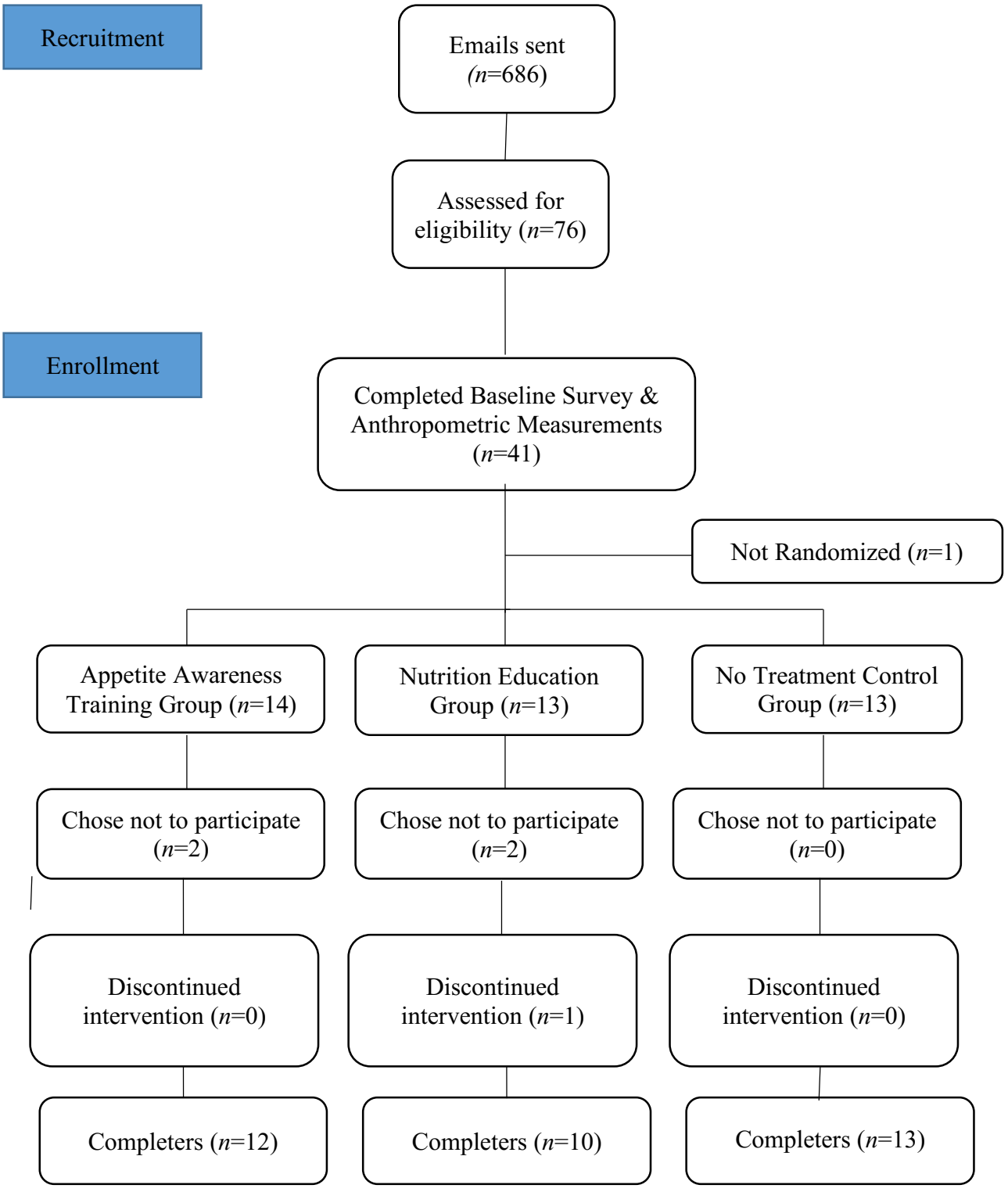


Figure 2. Participant flow-chart

consumed. Among control group participants, 62% ate two or more servings of vegetables daily, while only 17% of AAT and 10% of NE participants consumed the same amount. Participants did not show significant differences on any other demographic characteristics or health habits. This sample had a mean age of 18.06 (*SD* = 0.24). Participants were 9% Black, Non-Hispanic, 3% Native American, 86% White, and 3% Other. The mean weight of these participants was 66.92 kg (*SD* = 10.82), with a mean body fat percentage of 29.24 (*SD* = 7.02), and mean BMI of 24.46 (*SD* = 3.61). Of the final participant sample, 39% were overweight (BMI > 24.9) or obese (BMI > 29.9) at baseline. Additionally, when comparing participants' current weight to the weight they wanted to be in one year, 63% of participants wanted to lose at least 10 lbs. Across all participants, the mean weight loss participants were seeking in one year was 14.97 lbs. (*SD* = 11.79). See Table 1.

Based on a power analysis with our given sample size, we estimated that for most self-report measures (correlation between measures was generally *r* = .50 to .60) we had about 71-80% power to detect a medium effect (partial eta-squared .06) for the 3x2 interactions and 61-77% power for the 2x2 interactions. Thus our study was somewhat underpowered for many outcomes. For the weight and BMI outcomes, which were highly correlated from pre- to post-test (*r* = .98), the study was sufficient powered (99% power to detect a medium effect for all comparisons).

More than half the participants engaged in weekly or monthly self-weighing. Thirty-one percent of the sample had previously been on a diet, while 52% of study participants were currently dieting to lose weight or prevent weight gain. Roughly half of the participants reported healthy eating behaviors such as consistently eating breakfast,

and eating fruits and vegetables daily. Only one participant reported smoking cigarettes, and 37% endorsed engaging in binge drinking behaviors (4 or more drinks in one sitting) at least once in the previous month.

Table 1.

Sample Demographics and Health Behaviors

	Total *n=35*	AAT *n=12*	NE *n=10*	NTC *n=13*	
	% (n) or M (SD)	*% (n) or M (SD)*	*% (n) or M (SD)*	*% (n) or M (SD)*	*p*
Age	18.06 (0.24)	18.00 (0.00)	18.10 (0.32)	18.08 (0.28)	.58
Ethnicity (% White)	86% (30)	100% (12)	80% (8)	77% (10)	.21
BMI	24.46 (3.61)	24.10 (3.55)	26.34 (4.21)	23.35 (2.76)	.13
Highest vs. current weight (lbs)	-5.25 (6.78)	-4.96 (5.66)	-5.10 (4.95)	-5.67 (9.26)	.97
Ideal weight loss in 1 year (lbs)	-14.97 (11.79)	-14.33 (13.92)	-19.60 (12.66)	-11.75 (7.79)	.30
Weigh themselves weekly	23% (8)	8% (1)	40% (4)	23% (3)	.21
Previously dieted (% yes)	31% (11)	25% (3)	30% (3)	39% (5)	.76
Currently dieting to lose or avoid weight gain (% yes)	51% (18)	42% (5)	70% (7)	46% (6)	.37
Eats breakfast (days/week)	5.41 (1.95)	4.75 (2.26)	6.00 (1.70)	5.58 (1.78)	.31
Fruits 2+/day	49% (17)	42% (5)	40% (4)	62% (8)	.50
Vegetables 2+/day	31% (11)	17% (2)	10% (1)	62% (8)	.01
Diet is healthy*	4.11 (1.43)	3.75 (1.49)	4.00 (1.33)	4.54 (1.45)	.38
Health Status^	2.83 (0.89)	2.83 (1.12)	2,70 (1.06)	2.92 (0.49)	.85
Sleep (7-8 hrs/night)	74% (26)	58% (7)	80% (8)	85% (11)	.29
Current smoker	3% (1)	0% (0)	0% (0)	8% (1)	.42
Alcohol (total drinks/month)	12.41 (23.65)	7.46 (12.73)	6.30 (10.48)	21.69 (34.71)	.21
Alcohol (binge episodes/month)	2.03 (3.82)	1.92 (2.68)	1.00 (1.89)	2.92 (5.50)	.50

*Note. Data based on baseline characteristics; *1-7 Likert Scale, 1=disagree, 7=agree; ^1-5 Likert Scale, 1=poor, 5=Excellent*

Participation and Attendance

Over the course of the four intervention sessions, two AAT participants and two NE participants missed one intervention session. Of these, three participants (two AAT and one NE) completed make-up individual sessions with intervention facilitators to receive the information they missed during the session. In total, then, the intervention sessions had 98.9% attendance rates, with only one participant in the NE group missing one session.

Preliminary Analyses

Data Screening. Data was analyzed with SPSS (v. 23). All outcome variables were continuous and data were screened for normality and outliers. Relevant scales were appropriately recalculated with an outlier adjusted score for all further analysis. Identified outliers were adjusted to three standard deviations above or below the mean to match the next adjacent score in the accepted distribution (Mertler & Vannatta, 2005). The distribution of scores on the measure of overeating episodes continued to be positively skewed, so a log transformation was conducted for this outcome variable (Mertler & Vannatta, 2005).

Baseline Group Comparison. Groups were compared at baseline on all primary and secondary outcome variables using one-way ANOVAs. Results presented here, based on study completers, showed there were no statistically significant differences between the groups on any variables. Because the NE group's mean baseline BMI was noticeably higher than that of the other two groups, Cohen's *d* effect sizes were calculated to better assess the magnitude of the group differences, given the small sample size. The NE group showed a meaningfully higher pre-treatment BMI (NE vs. AAT, $d = 0.53$; NE vs.

NTC, $d = 0.60$). Notably, BMI was correlated with participants' weight loss ($r = -.41$, $p = .02$), with individuals of a higher BMI showing greater weight loss. BMI could not be used as a covariate in subsequent analyses, however, because BMI was an outcome itself and directly contributed to the outcome variable of participants' weight change over the course of the study.

Drop Out Analyses. In the current sample, only one participant was considered a drop out. This participant completed one of the intervention sessions but did not return for the post-treatment assessment and anthropometric measures. There was not enough data related to attrition to explore the possible systematic reasons for reduced participation, thus drop out analyses were not conducted. An intention-to-treat analysis using last observation carried forward was also not conducted because it seemed unlikely to alter the results by adding only one subject.

Correlations between measures. Correlations between the primary and secondary outcome measures were conducted using Pearson's r (see Appendix F). A number of the measures showed relatively high correlations with each other. Several of the measures were intended to assess similar concepts in slightly different ways thus explaining the correlations, while some of the correlations were somewhat unexpected. For future studies, the inclusion of such measures should be reassessed for utility.

Outcome Analyses[1]

Mixed factorial ANOVAs were utilized to compare changes that occurred between groups across time (pre-treatment to post-treatment). Only the group x time interaction was examined, as this analysis best reflects the changes over time as a result

[1] For the Plan B project, only data from baseline to post-treatment was analyzed and reported. Follow-up data will be later analyzed and incorporated into a manuscript for publication.

of treatment condition, and therefore best addresses the hypotheses. Post-hoc pairwise group comparisons (AAT vs. NTC; NE vs. NTC; AAT vs. NE) were further conducted if the group x time interaction was significant or nearing significance ($p < .10$). This *p*-value was selected due to the small sample size and exploratory nature of this pilot study. Interaction contrasts were examined to assess the statistical significance of the differences found between the paired groups over time also to compare the effect of the interventions (or lack thereof). As a post hoc test, interaction contrasts are identified as the most appropriate means to explore group x time comparisons in mixed factorial ANOVA as they break down larger interactions into a series of 2x2 interactions. (Page, Braver, & MacKinnon, 2003). Syntax was written in SPSS to conduct the interaction contrasts (Page et al., 2003).

Partial eta squared effect sizes were also calculated for the overall interaction as well as for the interaction for each pair of groups (AAT vs. NTC; NE vs. NTC; AAT vs. NE). Partial eta-squared acts as a measure of variance in indicating the proportion of variance from the dependent factor onto the outcome variable. This effect size provides information about the relative magnitude of the differences between groups, thereby providing an indication of practical significance (Lakens, 2013). Effect sizes are particularly important to consider in studies with small sample sizes that are underpowered to detect statistical significance. Values are represented as small (0.01), medium (0.06), or large (0.13) effect sizes (Lakens, 2013). Key outcomes are presented in Table 2.

Table 2.

Primary Outcomes

	AAT *(n=12)*	Nutrition *(n=10)*	Control *(n=12)*			AAT vs. NE	NE vs. NTC	AAT vs. NTC
	M (SD)	*M (SD)*	*M (SD)*	*p*	η^2	η^2	η^2	η^2
Weight (kg)*								
Baseline	65.12 (11.24)	71.83 (14.14)	64.88 (8.32)					
Post	64.74 (10.73)	71.06 (13.63)	65.64 (7.84)					
Change	-0.38 (1.50)	-0.77 (1.63)	0.76 (1.33)	.05	.17	.02	.23	.15
BMI*								
Baseline	24.10 (3.55)	26.34 (4.21)	23.70 (2.56)					
Post	23.98 (3.39)	26.06 (4.01)	23.99 (2.48)					
Change	-0.13 (0.56)	-0.28 (0.62)	0.29 (0.50)	.06	.17	.02	.23	.14
Body Fat*								
Baseline	27.18 (7.67)	31.73 (7.58)	27.48 (6.54)					
Post	28.22 (7.38)	31.84 (7.45)	28.09 (6.26)					
Change	1.03 (1.55)	0.11 (2.10)	0.61 (1.04)	.41	.06	.07	.03	.03
IES Physical								
Baseline	2.90 (0.83)	3.13 (1.02)	3.14 (0.69)					
Post	3.09 (0.46)	3.17 (1.03)	3.30 (0.70)					
Change	0.20 (0.69)	0.04 (0.91)	0.20 (0.89)	.89	.01	.01	.01	.00
IES Permission								
Baseline	3.42 (0.70)	2.72 (0.66)	2.87 (0.71)					
Post	3.54 (0.38)	2.83 (0.63)	3.15 (0.46)					
Change	0.13 (0.54)	0.11 (0.62)	0.28 (0.90)	.81	.01	.00	.01	.01
IAQ A*								
Baseline	2.69 (0.65)	2.55 (0.68)	2.92 (0.81)					
Post	2.66 (0.46)	2.69 (0.92)	2.78 (0.62)					
Change	-0.03 (0.41)	0.14 (1.00)	-0.14 (0.74)	.67	.02	.01	.03	.01
MEQ								
Baseline	2.58 (0.67)	2.98 (0.53)	2.42 (0.94)					
Post	2.72 (0.71)	3.06 (0.62)	2.52 (0.81)					
Change	0.13 (0.43)	0.08 (0.40)	0.11 (1.10)	.99	.00	.00	.00	.00
WELQ NEmot								
Baseline	6.92 (1.66)	6.73 (2.09)	7.52 (2.17)					
Post	7.44 (1.66)	7.33 (2.11)	7.56 (1.73)					
Change	0.52 (1.17)	0.60 (1.56)	0.04 (2.25)	.70	.02	.00	.02	.02

WELQ PosAct								
Baseline	6.60 (1.27)	7.88 (1.89)	6.87 (1.91)					
Post	7.81 (1.08)	7.35 (1.82)	6.81 (2.23)					
Change	1.21 (1.44)	-0.53 (1.27)	-0.06 (2.48)	.09	.14	.31	.01	.09
WELQ Avail								
Baseline	5.29 (1.75)	6.83 (1.97)	5.88 (2.82)					
Post	6.67 (1.74)	6.80 (1.86)	5.52 (2.46)					
Change	1.38 (1.82)	-0.03 (0.74)	-0.37 (2.58)	.08	.15	.21	.01	.14
WELQ Social								
Baseline	6.83 (2.18)	7.33 (2.23)	6.65 (2.04)					
Post	7.35 (1.76)	7.53 (1.94)	6.79 (2.24)					
Change	0.52 (1.47)	0.20 (1.48)	0.13 (2.28)	.86	.01	.01	.00	.01
WMSE								
Baseline	4.25 (1.58)	4.73 (1.28)	4.27 (1.19)					
Post	4.92 (1.51)	5.23 (0.72)	3.46 (1.23)					
Change	0.67 (1.58)	0.50 (1.30)	-0.81 (1.58)	.04	.18	.00	.18	.19
OE								
Baseline	4.67 (3.17)	3.20 (2.94)	7.65 (8.31)					
Post	3.83 (1.85)	2.05 (1.38)	6.27 (7.96)					
Change	-0.83 (3.01)	-1.15 (2.73)	-1.38 (7.90)	.89	.00	.01	.01	.00

Note. AAT=Appetite Awareness Training; NE=Nutrition Education; NTC=No Treatment Control; BMI=Body Mass Index; IES Physical = Intuitive Eating Scale-Physical Reasons subscale; IES Permission = Permission to Eat subscale; WELQ Social = Weight Efficacy Life Style Questionnaire- Social Eating subscale; IAQ A=Interoceptive Awareness Questionnaire-Appetite Subscale; MEQ=Mindful Eating Questionnaire; WELQ NEmot= Weight Efficacy Lifestyle Questionnaire-Negative Emotion Subscale; WELQ PosAct= Weight Efficacy Lifestyle Questionnaire-Positive Activity Subscale; WELQ Avail= Weight Efficacy Lifestyle Questionnaire-Food Available Subscale; WMSE = Weight Management Self-Efficacy; OE = Overeating Episodes. Unadjusted values used for means and standard deviations; Outlier Adjusted values used for p-values and effect sizes.
**Negative change score indicates improvement.*

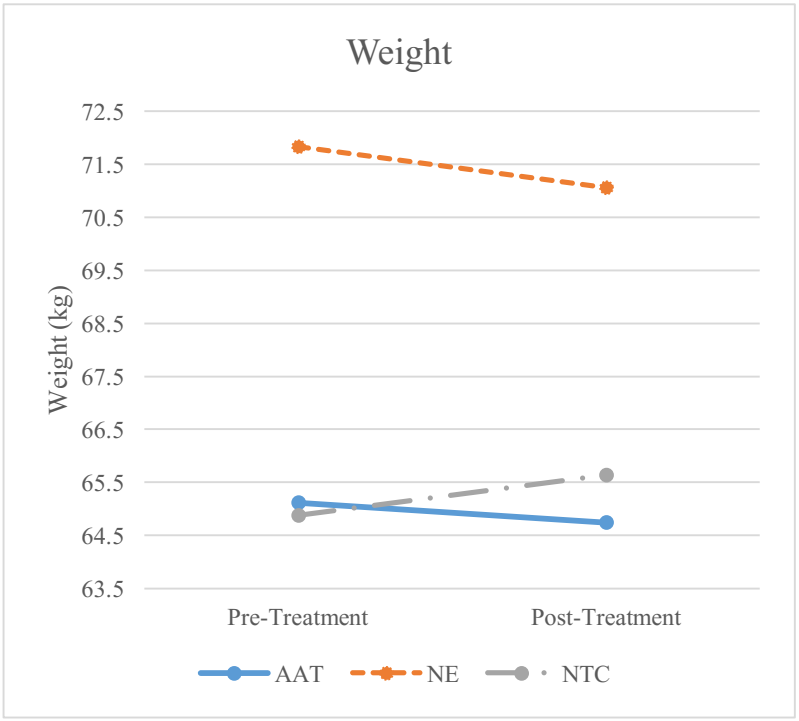
Anthropometric Outcomes

Mixed factorial ANOVAs were completed to compare the three groups over time on weight, BMI, and percent body fat. All results reported below are based on the treatment group x time interaction. For weight, the group x time interaction was nearing statistical significance, $F(1, 31) = 3.234$, $p = .053$, $\eta^2 = .17$ (large effect). Both the AAT

and NE groups showed weight loss (0.38kg, 0.77 kg, respectively) at the post-treatment assessment period compared to NTC group participants who gained weight (0.76 kg) from the pre- to post-treatment period. Interaction contrasts revealed that the difference between the NE and NTC weight change was statistically significant, $F(1, 31) = 5.79$, $p = .022$; $\eta^2 = 0.23$ (large effect) and the AAT versus NTC difference was nearing significance, $F(1, 31) = 3.5$, $p = .07$, $\eta^2 = .15$ (large effect). The differences between AAT and NE groups was not significant. Similar findings were shown between the three groups on BMI, $F(2, 31) = 3.174$, $p = .056$; AAT vs. NTC $\eta^2 = .14$ (large effect); NE vs. NTC $\eta^2 = 0.23$ (large effect; see Figure 3). Percent of body fat did not significantly differ between groups over time, $F(2, 31) = 0.922$, $p = .41$, $\eta^2 = .06$ (medium effect).

Eating and Weight Regulation Self-Efficacy

There were several meaningful group differences related to changes in eating and weight regulation self-efficacy. The group x time interaction for the WELQ-Food Available subscale was nearing statistical significance, $F(2, 32) = 2.73$, $p = .08$, $\eta^2 = .15$ (large effect), with participants in the AAT group showing greater increases than participants in the NE and NTC groups in their reported ability to resist eating in situations when food was highly available (AAT vs. NE $\eta^2 = .21$, large effect; AAT vs. NTC $\eta^2 = .14$, large effect; NE vs. NTC $\eta^2 = .01$, small effect). Interaction contrasts showed that the AAT vs. NTC comparison was statistically significant, $F(1, 32) = 5.00$, $p = .032$, but the other comparisons were not.



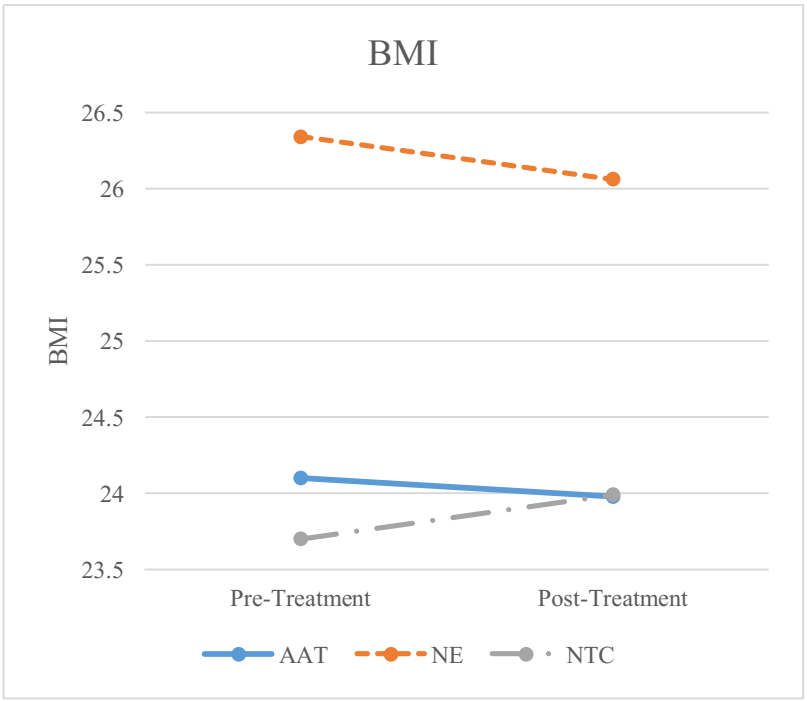


Figure 3. Means for weight and BMI pre- and post-treatment

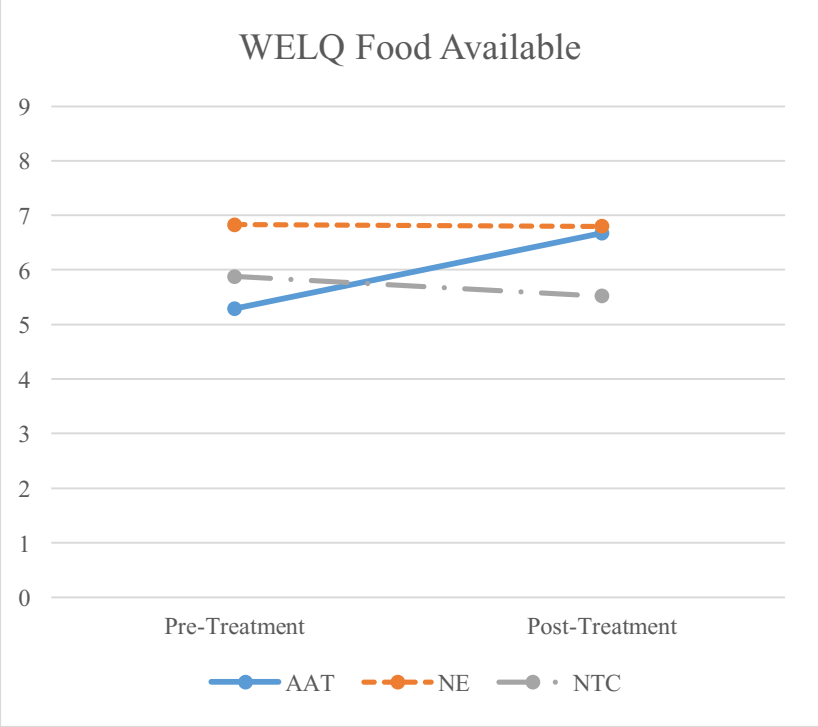


Figure 4. Means for WELQ Food Available Scale pre- and post-treatment

Additionally, there was a group by time interaction nearing significance on the Positive Activities subscale of the WELQ, $F(2, 32) = 2.63$, $p = .09$, $\eta^2 = .14$ (large effect). Interaction contrasts showed that the AAT group participants reported greater confidence in controlling their eating during activities such as watching television or reading and/or completing homework than the NE group, $F(1, 32) = 4.73$, $p = .037$, $\eta^2 = .31$ (large effect) and the NTC group, $F(1, 32) = 2.89$, $p = .10$, $\eta^2 = .09$ (medium effect).

Small, but non-statistically significant effects were noted for the other WELQ scales (Negative Emotion, Physical Discomfort, Social Situations), with all variables changing in the expected direction (intervention groups showing greater improvements than the control group). See Table 2 for effect sizes.

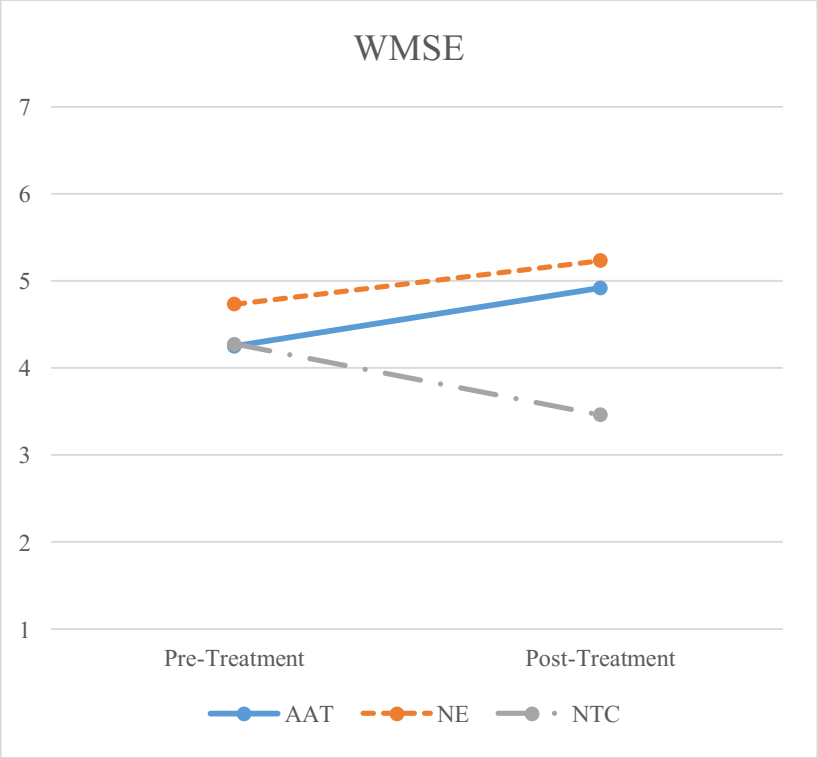


Figure 5. Means for WMSE Scale pre- and post-treatment

The treatment x time interaction was statistically significant for Weight Management Self-Efficacy, $F(2, 32) = 3.55$, $p = .04$, $\eta^2 = .18$ (large effect). Participants in the AAT and NE groups showed an increase in their ability to feel efficacious in managing their weight beyond participants in the NTC group (AAT vs. NTC $\eta^2 = .19$, large effect; NE vs. NTC $\eta^2 = .18$, large effect; see Figure 5). Interaction contrasts revealed that these differences were also statistically significant (AAT vs. NTC, $F(1, 32) = 5.97$, $p = .02$; NE vs. NTC, $F(1, 32) = 4.26$, $p = .047$, respectively).

There was little difference found between the groups over time on levels of appetite awareness as measured by the IAQ Appetite subscale, $F(2, 32) = .40$, $p = .67$, $\eta^2 = .02$ (small effect). Regarding levels of intuitive eating, particularly attending to restraint

and overeating behaviors, the IES did not show significant differences between the three groups over time, $F(2,31) = .212$, $p = .81$. Additionally, the MEQ disinhibition subscale indicated no significant differences in levels of overeating, $F(2, 32) = .014$, $p = .99$. Finally, there were no significant differences found between the three groups over time on episodes of overeating, $F(2, 32) = .554$, $p = .58$.

Secondary Outcome Analyses

Results from secondary outcomes are presented in Appendix G. Regarding body image outcomes, AAT and NE group participants showed a tendency to regress from societal norms deeming thin bodies as ideal; both treatment groups showed a decline in their Ideal-Body Satisfaction Scale scores indicating a greater acceptance of varying body types, while NTC group participants' scores increased, $F(2, 32) = 5.01$, $p = .01$. Interaction contrasts revealed that NE participants showed a statistically significant reduction in their valuing of a thin idea compared to control group participants $F(1,32) = 9.08$, $p = .005$, $\eta^2 = .28$ (large effect). The AAT group also showed a significant improvement in this area compared to the NTC group, $F(1,32) = 5.01$, $p = .032$, $\eta^2 = .18$ (large effect). There were no statistically significant group x time interactions between groups on actual body satisfaction, though small to medium effect sizes were found between groups. AAT participants showed greater body satisfaction than the NE group, $\eta^2 = .03$ (small effect), and the NTC group, $\eta^2 = .07$ (medium effect) when exploring group effect sizes.

There were significant differences found as measured by the IPAQ, between the groups on levels of sedentary behavior. Interaction contrasts showed AAT and NE participants increased levels of sedentary behavior, while NTC group participants

reduced levels of sedentary behavior $F(2, 31) = 3.75$, $p = .04$. The differences between the NTC group and the AAT and NE showed a significant effect $\eta^2 = .20$ (large effect). No statistically significant differences were found between groups on change in levels of physical activity; however, the AAT participants increased their levels of physical activity while the NE and NTC group decreased activity levels (see Appendix G). Significant effects were found between the AAT and NE groups $\eta^2 = .07$ (medium effect) but not between NTC and AAT or NE.

Changes in mood (positive and negative) among the three groups were not statistically significant, however small to medium effect sizes were found. Participants in the AAT group increased the frequency of experiences with positive emotions more than NE participants, $\eta^2 = .11$ (medium effect) and NTC participants $\eta^2 = .18$ (large effect). Concerning negative emotions, NE participants experienced a greater reduction in experiences of negative emotions than AAT participants $\eta^2 = .09$ (medium effect) and NTC participants $\eta^2 = .08$ (medium effect).

Program Evaluation

The program evaluation (see full results in Appendix E), completed by all intervention participants following the final intervention session, revealed that 86% of participants were satisfied or extremely satisfied with the overall intervention. Concerning the intervention group leaders and other study staff, 86% of participants indicated being satisfied or extremely satisfied. Ninety-six percent of participants believed that the length and duration of the intervention was acceptable and endorsed feeling that the intervention had helped them eat in ways that would help prevent weight gain. NE participants indicated that learning about serving sizes was most helpful, while

AAT participants endorsed the discussions about focusing on how much and when you eat, rather than what you eat, was most helpful. Several participants disclosed that they have changed their behaviors as a result of the intervention; the most common responses included incorporating more fruits and vegetables or healthier foods into their diets (NE group), and paying more attention to how much and when they are eating (AAT group). Suggestions for intervention improvement included having the participants interact with each other more (NE group, $n = 1$), having the ability to see individual results (AAT group, $n = 1$), and having a one-on-one session included in the intervention (NE group, $n = 1$). Every participant indicated that they would recommend the intervention they received to someone else with similar concerns about maintaining their weight and preventing unintended weight gain.

Discussion

The current study aimed to add to the limited body of research examining AAT as a preventative intervention for weight gain and dysregulated eating behaviors. It was hypothesized that individuals receiving the AAT intervention would increase their levels of appetite awareness, intuitive eating and eating self-regulation, and decrease restrictive and binge-eating behaviors. By incorporating the skills taught through AAT, participants were hypothesized to increase their healthy eating behaviors, thus preventing unintended weight gain. We believed that individuals in the AAT intervention group would respond with greater change related to their intuitive eating abilities, self-regulatory eating processes, and restrictive and binge eating practices, compared to both the nutritional education and control conditions. We predicted that individuals in both the NE group and

the AAT group would maintain a relatively stable weight throughout the 6-week duration of the intervention, whereas the NTC group would gain the expected 2-3 pounds.

Study results confirmed our hypothesis that participants in the AAT and NE intervention group would be able to prevent weight gain more than individuals in the NTC group; as expected, participants in both the AAT and NE group lost weight (0.84 lbs. and 1.70 lbs., respectively), whereas the NTC group participants gained weight (1.68 lbs.) from pre- to post-treatment assessment periods. The results support the use of an active intervention to increase awareness of eating behaviors. With the added element of self-monitoring in each active intervention group, participants were likely to change unhealthy or maladaptive eating behaviors and replace or alter them with new behaviors congruent with the specific intervention group objectives (e.g., eating in response to physiological hunger cues [AAT], eating recommended portion sizes [NE]). It should also be noted that there was a meaningful (but not statistically significant) difference between groups at baseline with respect to weight and BMI, with the NE group having higher BMI/weight at baseline. Given that baseline BMI was also associated with greater weight loss, regardless of group status, it is possible that the NE group weight loss may in part be due to regression to the mean effects or other intrapersonal factors, such as motivation to lose weight.

In contrast to the weight loss experienced in the two intervention groups, participants in each of the groups showed an increase in body fat percentage. This may be related to a decrease in activity level over the course of their first semester in college; however, post-hoc analysis showed there was no correlation between levels of body fat change among participants and levels of self-reported exercise or sedentary activity

change. Future studies should further explore changes in other types of body composition (e.g., waist circumference, lean body mass) and use more reliable measures of body fat. It seems possible that meaningful changes in other types of body composition may arise simultaneously as weight and BMI increase or decrease. Namely, the influence of lean muscle mass loss on weight over time may not be the same indication of health as a decrease in weight due to loss of body fat. When using only weight and BMI as primary outcomes, such distinctions may be lost.

Appetite awareness was not found to differ between the three groups over time, and in fact, the AAT group showed no change in score on the IAQ-Appetite subscale. This finding may be related to the use of a non-eating disordered population within the current study, as previous research showing a change in appetite awareness has utilized participants with eating disordered pathology (Buckner, 2007; Smith, 2007). Indeed, examination of pre- and post-treatment scores on the measure assessing for appetite awareness (IAQ-Appetite subscale) suggest that intervention participants began the intervention with a confidence in their ability to understand and follow their appetite cues (M = 2.74, SD = 0.72; 1-6 Likert scale, with lower scores indicating more interoceptive awareness). Additionally, the actual practice of tuning in to internal cues and increasing appetite awareness may not have been emphasized as much as other strategies throughout the intervention sessions. For example, it may be that participants developed more strategies for resisting temptations to eat, rather than learning to be more aware of their appetite. Training in appetite awareness, then, did not seem to be a key component in creating behavior change among participants.

Participants in the active intervention groups did, however, show significant findings in other targets variables. Intervention participants (AAT and NE) showed a greater increase in their perceived ability to efficaciously manage their weight and resist eating across different situational contexts. AAT participants showed an increase in their ability to control their eating in situations where food was highly available and while engaging in activities like watching television and completing homework or reading. This finding could have been related to many factors. The change in these variables may have been related to the focus on social eating and eating when food was available within the intervention sessions, or an emphasis on mindful eating practices. A shift in attitudes was also emphasized to reduce the feelings of obligation participants may have felt when around food while lacking physical hunger.

It was expected that, following the intervention, participants in the AAT group would show greater control over their ability to managing urges to eat in the face of negative emotions. In fact, the topic of stress-related eating was commonly brought up by participants as a concern and thus regularly addressed. It may be that more emphasis needs to be placed on this component of the intervention. It might also be that eating in response to negative emotions is more difficult to manage and change.

It was also anticipated that overeating episodes would decrease following either intervention, but there were no significant group differences in overeating frequency change. Few participants endorsed binge eating behaviors within the intervention sessions, thus behaviors such as social eating were of greater focus, and so it may not be surprising that binge eating did not change. Also notable, there was considerable variability in individuals' self-report of this behavior, and thus repeating the study with a

larger sample size might bring more clarity to the possible effects the intervention could have on overeating and binge eating behavior.

AAT participants showed a positive development in attitudes toward an ideal body type, increasing their acceptance of a variety of body types, as well as increasing their satisfaction with their own body. Neither group included any discussion of body image nor specifically targeted this outcome, yet receiving treatment appeared to improve perceptions of the importance of having a thin body. Such results have also been seen in similar studies looking at interventions for disordered eating and weight gain prevention for young adults (Stice & Agras, 1998; Stice et al., 2013). This change seen in intervention participants may have been related to the emphasis on personalizing eating behaviors to what seems to work for each individual, thereby influencing thinking about self in relation to others.

Both brief AAT and NE interventions seem to have a positive impact on participants' perceived ability to prevent unintended weight gain and efficaciously maintain their weight. The NE group effectively addressed ways in which participants could alter their eating habits to ensure they were getting proper nutrients according to governmental recommended guidelines. Within the AAT group, there was a greater focus on how to use internal hunger and fullness cues to guide participants' in their eating habits. Additionally, participants strategized with facilitators on how to effectively deal with contextual situations in which they may be more likely to eat for reasons other than hunger. These results indicate a treatment effect for those participants who were involved in an active treatment condition, confirming expected results that brief interventions are

more effective than no intervention. Both interventions were thus shown to be effective in the short term, but greater group differences may occur over a longer period of time.

As seen through commentary in the program evaluation, participants in an active intervention are likely to increase their awareness to what, how much, and when they are eating. The brief interventions increased their awareness of their eating behaviors, which was supported by the self-monitoring required in each intervention group. This may be beneficial in increasing overall awareness of eating behaviors, with an impact on mindless eating and avoiding unintended weight gain. Participants found the interventions to be helpful overall, and reported finding benefit to their involvement.

Limitations

The current study addressed several limitations from prior studies. The incorporation of the nutrition psychoeducation group allowed us to protect against results relating exclusively to an active treatment condition. However, there are certain limitations to this study that should be considered. The primary limitation of this study has to do with the small sample size. The sample size was likely impacted by the timing of the study, as it began at a considerably busy time for these freshman students. Several students inquired about participating in the study after the study had already begun, thus were not able to participate. Additionally, students may have felt intimidated by starting the study on their own prior to establishing relationships on campus; many of the students who did enroll in the study signed up with roommates or friends. The timing, however, was intentional in order to best capture the true impact of the college transition on unintentional weight gain. In the future, it may be necessary to increase recruitment efforts in order to increase participation.

Another limitation of the study may lie in the comfort levels of the participants. There is a possibility that those receiving the interventions were uncomfortable discussing or disclosing sensitive information. Study participants may have been influenced by social desirability limiting how involved they were in the intervention sessions. This may have influenced levels of disclosure regarding areas in which the participants struggled or influences on their eating behaviors. Participation may have also been influenced by the comfort with intervention sessions leaders. Because the two active intervention groups had different session leaders, there may have been an effect on participants based on facilitator differences. The sample size was too small to compare effects of groups within an intervention arm. Future studies may wish to incorporate a measure evaluating participants' social desirability to assess these possibilities.

Finally, the use of self-report measures in assessing most of the outcomes is a limitation of this study. Definitions of these concepts were not included in the questionnaires, thus the interpretation of such terms was susceptible to the interpretation of the individual participant. In addition, participants' responses may not reflect true changes, as it is possible that they were influenced by social desirability and/or expectancy effects when answering questions. Participants may have felt a need to please study facilitators by stating they learned new strategies that will help them successfully prevent weight gain. Study participants may have also lacked appropriate insight into their own behaviors to appropriately complete the self-report measures. Conversely, some participants may have underreported some undesirable behaviors (e.g., binge-eating) at baseline, but increased their comfort in discussing these topics as a result of the group interaction.

Future Directions

In the future, it will be beneficial to analyze the follow-up data to explore group differences across all three time points. Our hypotheses including analysis of the data at the 4-month follow-up period, in which we expected the AAT group to surpass the NE group in levels of appetite awareness and sustained weight gain prevention. Follow-up analyses may also indicate whether effects seen through participation in an active treatment group remained after in-person sessions concluded or if results seemed to have a short-term effect.

Future studies should seek to recruit a larger sample size in order to increase the power to detect meaningful group differences. Increasing sample sizes will also provide greater clarification on the group differences and treatment interactions. In the current study, we were unable to conduct mediator and moderator analyses due to the limited sample size; with larger sample sizes, data would be available to examine mechanisms of change within the treatment groups. Current plans to repeat this study in the Fall semester of 2016 will seek address this limitation.

It may be beneficial to consider including male participants and older students in the AAT intervention to consider gender and age differences, as well as the ability to generalize intervention results to a greater population of subjects. Research has shown that males are affected in different ways than females regarding weight gain and maladaptive eating behaviors, thus the two groups may react differently to the interventions (Cooley & Toray, 2001; Grossbard, Lee, Neighbors, & Larimer, 2009; Mihalopoulos, Auinger, & Klein, 2008). In addition, the inclusion of males and older students may increase sample sizes allowing for greater power in statistical analyses.

Regarding the incorporation of self-monitoring, different forms of self-monitoring may be considered in future studies. There is currently a mobile application in the development phase, which may be considered for future studies with AAT. The application would allow AAT participants to electronically monitor their eating episodes, specifically documenting their hunger and fullness levels each time they eat. It would also allow participants to track times that they ate, and make notes about types or amounts of foods, external influences on their food choice or choice to eat, and whether or not they engaged in restrictive or binge-eating behaviors. Notes of this nature can be used to establish patterns in the participants eating behaviors, allowing for greater personalization in treatment approaches. The accessibility of the mobile application to record participants' records of eating episodes may also influence the compliance and/or ease of self-monitoring required in the Appetite Awareness Training.

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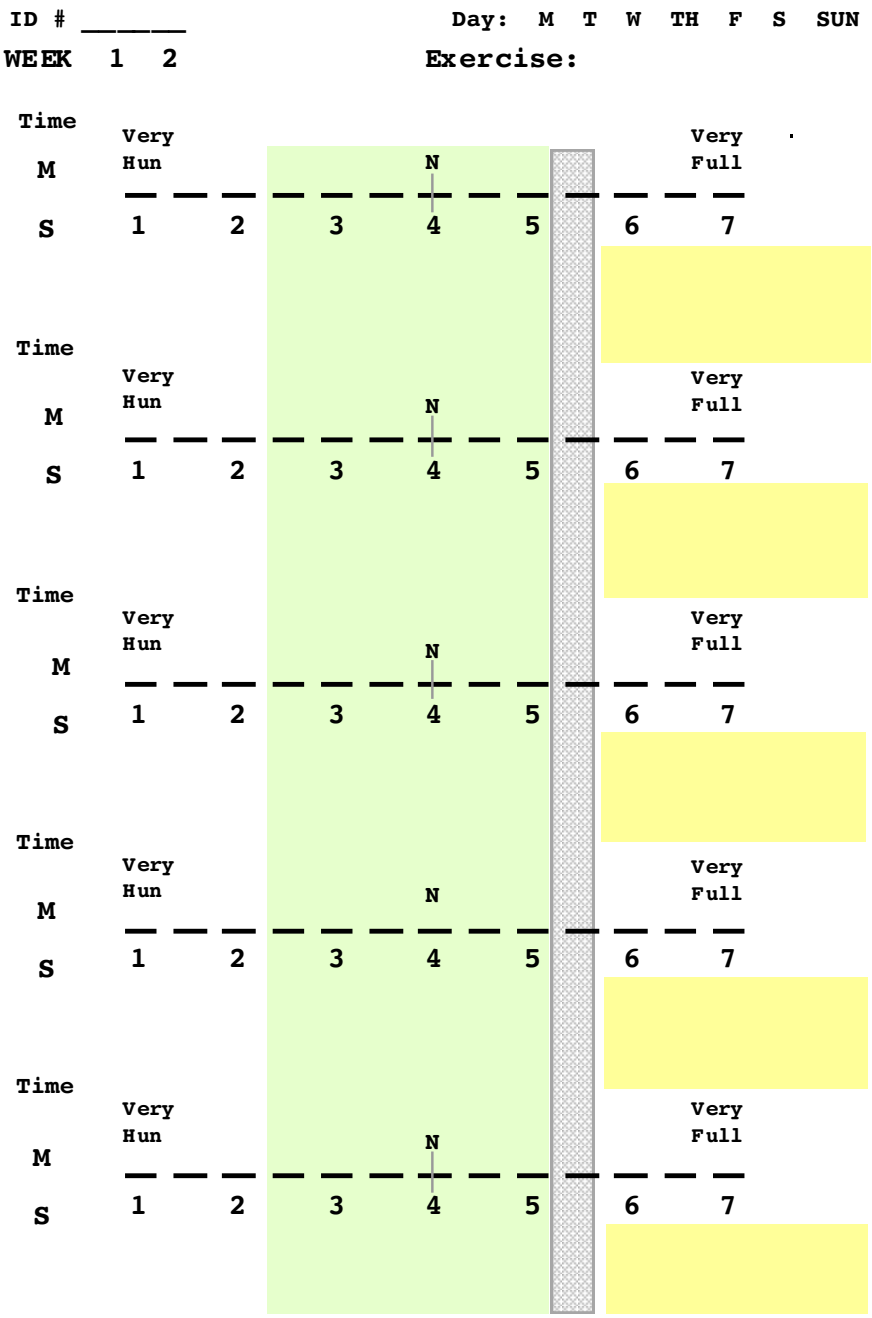
APPENDIX A: RECORD OF EATING EPISODES



APPENDIX B: SAMPLE INTERVENTION OVERVIEW

Session	Topics and Intervention Strategies: AAT Group
1 1 hr	• Group guidelines and support building exercise • Basic Introduction to AAT (rationale; description) • In vivo AAT (hunger/fullness ratings for meals eaten that day) • Homework: AAT monitoring (hunger/fullness, too hungry/too full, eating when not hungry, mindful eating)
2 1 hr	• Review homework ▪ Address issues/difficulties • AAT "Food Available" • AAT "What the Heck" and "What the heck" ways of thinking • Homework: AAT monitoring (add food available and what the heck)
3 1 hr	• Review homework ▪ Address issues/difficulties • AAT Food Type • AAT nutrition and snack guidelines • AAT emotional eating • Self-care, alternative ways to self-soothe
Booster 1 hr	• Review progress & maintenance of behavior change ▪ Summarize most helpful strategies • Address issues/difficulties • Post-Treatment Assessment & Program Evaluation

Session	Topics & Intervention Strategies: Nutrition Group
1 1 hr	• Group guidelines and introductions/group cohesion exercise • Energy balance: What is a calorie; energy intake and expenditure; calculating calorie needs • Weight management guidelines, helpful strategies • Nutrition Basics: macro- and micro-nutrients, nutrients of special concern, alcohol • Introduction to food logging and tracking • Homework: Food Log (time, food, amount of food, calories)
2 1 hr	• Review last week's food log – observation and reflection • Introduction to MyPlate - USDA Guidelines ▪ Food Groups – what they are and healthful choices from each ▪ How many servings do I need of each food group? • Create "My Daily Food Plan" based on individual needs • Goal Setting for healthier eating
3 1 hr	• Goal check in • Eating healthy on campus • Meal planning and grocery shopping • Reading nutrition facts labels • Dining out and recipe modification
Booster 1 hr	• Review progress & maintenance of behavior change • Problem solving, address barriers to change • Post-Treatment Assessment & Program Evaluation

APPENDIX C: RECRUITMENT EMAIL

Subject Line: Concerned about Freshman Weight Gain? Read on…

E-mail text:

Are you worried about freshmen weight gain?

Are you concerned about managing your eating in the dining halls?

If so, you might be interested in participating in a research study examining methods of controlling weight and eating behaviors to prevent unintended weight gain in freshman women. This intervention is FREE to you and you will even get paid to complete certain assessments.

If you choose to participate, you will be randomly assigned to one of three groups. Two groups will be asked to participate in four 1-hour small-group sessions on campus over a period of six weeks, starting near the start of the semester. Two of the groups will learn various strategies for maintaining a healthy weight. The third group will complete a set of assessments, but will not receive any further instruction or attend weekly sessions until after the study is completed.

There are a few others things you will be asked to do if you choose to participate. Regardless of which group you are assigned to, you will be asked to complete an online questionnaire and have your height and weight measured at three different times; once within the next week, once about six weeks later and once in six months. You will receive a $15 Target gift card when you complete the 6-week assessment and another $15 gift card when you complete the 6 month assessment.

If you are interested in participating, please complete the following brief online questionnaire to confirm your eligibility. If you qualify, you will be contacted and provided with more study details and told how you can get started!

Click this link to get started: **http://tinyurl.com/umdfreshman**

Please email aat@d.umn.edu with any questions.

APPENDIX D: QUESTIONNAIRES

Initial Screening Questionnaire:

Name:
Age:
Dorm: Floor:

How concerned are you about weight gain this year?
1-7 (not at all – extremely concerned)
Indicate your interest in participating:
1-7 (not at all-extremely interested)
Which of the following times could you attend an intervention session?
List time slots
If you are selected to participate in this study, how likely are you to attend all 4 group sessions?
1-7 (not at all likely, extremely likely)

Pre-test, Post-test, Follow-up questionnaire (draft form)

Age _____

Race/Ethnicity
- ❍ Asian or Pacific Islander (1)
- ❍ Black, Non-Hispanic (2)
- ❍ Hispanic (3)
- ❍ Native American (American Indian) (4)
- ❍ White, Non-Hispanic (5)
- ❍ Other (6) _____

The following questions ask about your weight and dieting history.

What is your current weight?
Pounds (1)

What is your current height?
Feet (1)
Inches (2)

What is the most you have ever weighed since reaching your current height (do not count any weight gains due to medical conditions or medication)?
Pounds (1)

How often do you weigh yourself?
- ❍ Daily (1)
- ❍ Weekly (2)
- ❍ Monthly (3)
- ❍ A few times per year (4)
- ❍ Once per year (5)
- ❍ Never (6)

For about how long have you been at or close (within 2 lbs.) to your present weight? (please include a unit of time such as, 3 days or 3 weeks or 3 months)

Which of these statements best describe what has happened to your weight during the past 6 months?
- ❍ My weight has stayed about the same (1)
- ❍ I've been losing weight (2)
- ❍ I've been gaining weight (3)
- ❍ My weight has fluctuated a lot (4)

Have you ever been on a diet to control your weight?
- ❍ Yes (1)
- ❍ No (2)

If No Is Selected, Then Skip To Are you currently dieting to lose weight or to avoid gaining weight?

About how old were you when you went on your first diet?

Please estimate as best you can the number of times in your life you have dieted and lost the indicated amount of weight: How many times have you dieted and lost:

1-4 pounds (1)
5-10 pounds (2)
11-15 pounds (3)
16 or more pounds (4)

Are you currently dieting to lose weight or to avoid gaining weight?
- ❍ To lose weight (1)
- ❍ To avoid gaining weight (2)
- ❍ I am not dieting (3)

Currently, what weight (in pounds) would you like to be in:

3 months? (1)
6 months? (2)
1 year? (3)

Intuitive Eating Scale

For each item below, please check the answer that best characterizes your attitudes or behaviors.

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
I try to avoid certain foods high in fat, carbohydrates, or calories. (1)	❍	❍	❍	❍	❍
I find myself eating when I'm feeling emotional (e.g., anxious, depressed, sad), even when I'm not physically hungry. (2)	❍	❍	❍	❍	❍
If I am craving a certain food, I allow myself to have it. (3)	❍	❍	❍	❍	❍
I get mad at myself for eating something unhealthy. (4)	❍	❍	❍	❍	❍
I find myself eating when I am lonely, even when I'm not physically hungry. (5)	❍	❍	❍	❍	❍
I have forbidden foods that I don't allow myself to eat. (6)	❍	❍	❍	❍	❍
I use food to help me soothe my negative emotions. (7)	❍	❍	❍	❍	❍
I find myself eating when I am stressed out, even when I'm not physically hungry. (8)	❍	❍	❍	❍	❍
I am able to cope with my negative emotions (e.g., anxiety, sadness) without turning to food for comfort. (9)	❍	❍	❍	❍	❍
When I am bored, I do NOT eat just for something to do. (10)	❍	❍	❍	❍	❍
When I am lonely, I do NOT turn to food for comfort. (11)	❍	❍	❍	❍	❍
I find other ways to cope with stress and anxiety than by eating. (12)	❍	❍	❍	❍	❍
I allow myself to eat what food I desire at the moment. (13)	❍	❍	❍	❍	❍
I do NOT follow eating rules or dieting plans that dictate what, when, and/or how much to eat. (14)	❍	❍	❍	❍	❍

Interoceptive Awareness Questionnaire

Please indicate your responses to the following questions based on what has been true for you over the past month.

	Never (1)	Rarely (2)	Sometimes (3)	Often (4)	Usually (5)	Always (6)
I get frightened when my feelings are too strong. (1)	❍	❍	❍	❍	❍	❍
I get confused about what emotion I am feeling. (2)	❍	❍	❍	❍	❍	❍
I continue to eat after I feel full. (3)	❍	❍	❍	❍	❍	❍
I can clearly identify what emotions I am feeling. (4)	❍	❍	❍	❍	❍	❍
I eat when I am not hungry. (5)	❍	❍	❍	❍	❍	❍
I don't notice I'm full until I'm stuffed. (6)	❍	❍	❍	❍	❍	❍
I don't know what's going on inside me. (7)	❍	❍	❍	❍	❍	❍
I get confused as to whether or not I am hungry. (8)	❍	❍	❍	❍	❍	❍
I worry that my feelings will get out of control. (9)	❍	❍	❍	❍	❍	❍
I feel bloated after I eat a normal meal. (10)	❍	❍	❍	❍	❍	❍
When I am upset, I don't know if I am sad, frightened, or angry. (11)	❍	❍	❍	❍	❍	❍
I can't tell when I feel full. (12)	❍	❍	❍	❍	❍	❍
I feel out of touch with my hunger feelings. (13)	❍	❍	❍	❍	❍	❍
I have feelings I can't quite identify. (14)	❍	❍	❍	❍	❍	❍
When I am upset, I worry that I will start eating. (15)	❍	❍	❍	❍	❍	❍
I try not to eat until I'm very hungry. (16)	❍	❍	❍	❍	❍	❍
I don't notice I'm hungry until I'm ravenous. (17)	❍	❍	❍	❍	❍	❍
I don't notice that I'm a little too full until after I've stopped eating. (18)	❍	❍	❍	❍	❍	❍

Mindful Eating Questionnaire

Please select the answer that best fits your behavior:

	Never/Rarely (1)	Sometimes (2)	Often (3)	Usually/Often (4)
I stop eating when I'm full even when eating something I love. (1)	❍	❍	❍	❍
When a restaurant portion is too large, I stop eating when I'm full. (2)	❍	❍	❍	❍
When I eat at "all you can eat" buffets, I tend to overeat. (3)	❍	❍	❍	❍
If there are leftovers that I like, I take a second helping even though I'm full. (4)	❍	❍	❍	❍
If there's good food at a party, I'll continue eating even after I'm full. (5)	❍	❍	❍	❍

Weight Efficacy Lifestyle Questionnaire

Read each statement and then pick the appropriate number to the right.

	Not Confident (0)	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	Very Confident (9)
I can resist eating when I am anxious (nervous). (1)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I am depressed (or down). (2)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I am angry (or irritable). (3)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I have experienced failure. (4)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can control my eating on the weekends. (5)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when there are many different kinds of food available. (6)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when I am at a party. (7)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when high-calorie foods are available. (8)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when I have to say "no" to others. (9)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when I feel it's impolite to refuse a second helping. (10)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when others are pressuring me to eat. (11)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when I think others will be upset if I don’t eat. (12)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I feel physically run down. (13)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating even when I have a headache. (14)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

I can resist eating when I am in pain. (15)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I feel uncomfortable. (16)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I am watching TV. (17)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I am reading. (18)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating just before going to bed. (19)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍
I can resist eating when I am happy. (20)	❍	❍	❍	❍	❍	❍	❍	❍	❍	❍

Ideal-Body Stereotype Scale-Revised

How much do you agree with these statements?

	Strongly Disagree (1)	Disagree (2)	Neutral (3)	Agree (4)	Strongly Agree (5)
Slender women are more attractive. (1)	❍	❍	❍	❍	❍
Women who are in shape are more attractive. (2)	❍	❍	❍	❍	❍
Tall women are more attractive. (3)	❍	❍	❍	❍	❍
Women with toned (lean) bodies are more attractive. (4)	❍	❍	❍	❍	❍
Shapely women are more attractive. (5)	❍	❍	❍	❍	❍
Women with long legs are more attractive. (6)	❍	❍	❍	❍	❍

Berscheid's Body Dissatisfaction Scale

Over the past MONTH, how satisfied were you with your...

	Extremely Dissatisfied (1)	Moderately Dissatisfied (2)	Neutral (3)	Moderately Satisfied (4)	Extremely Satisfied (5)
Weight (1)	❍	❍	❍	❍	❍
Figure (2)	❍	❍	❍	❍	❍
Stomach (3)	❍	❍	❍	❍	❍
Body Build (4)	❍	❍	❍	❍	❍
Waist (5)	❍	❍	❍	❍	❍
Thighs (6)	❍	❍	❍	❍	❍
Buttocks (7)	❍	❍	❍	❍	❍
Hips (8)	❍	❍	❍	❍	❍
Legs (9)	❍	❍	❍	❍	❍
Breasts (10)	❍	❍	❍	❍	❍

Weight Maintenance Self-Efficacy

For the following questions, please describe the number that best describes how you feel.

	Not at all true (1)	(2)	(3)	(4)	(5)	(6)	Very true (7)
I feel confident in my ability to manage my weight. (1)	❍	❍	❍	❍	❍	❍	❍
I now feel capable of managing my weight. (2)	❍	❍	❍	❍	❍	❍	❍
I am able to manage my weight permanently. (3)	❍	❍	❍	❍	❍	❍	❍
I am able to meet the challenge of managing my weight. (4)	❍	❍	❍	❍	❍	❍	❍

Positive and Negative Affect Scale

Indicate to what extent you have felt this way during the past few weeks:

	Very slightly or not at all (1)	A little (2)	Moderately (3)	Quite a bit (4)	Extremely (5)
Interested (1)	❍	❍	❍	❍	❍
Distressed (2)	❍	❍	❍	❍	❍
Excited (3)	❍	❍	❍	❍	❍
Upset (4)	❍	❍	❍	❍	❍
Strong (5)	❍	❍	❍	❍	❍
Guilty (6)	❍	❍	❍	❍	❍
Scared (7)	❍	❍	❍	❍	❍
Hostile (8)	❍	❍	❍	❍	❍
Enthusiastic (9)	❍	❍	❍	❍	❍
Proud (10)	❍	❍	❍	❍	❍
Irritable (11)	❍	❍	❍	❍	❍
Alert (12)	❍	❍	❍	❍	❍
Ashamed (13)	❍	❍	❍	❍	❍
Inspired (14)	❍	❍	❍	❍	❍
Nervous (15)	❍	❍	❍	❍	❍
Determined (16)	❍	❍	❍	❍	❍
Attentive (17)	❍	❍	❍	❍	❍
Jittery (18)	❍	❍	❍	❍	❍
Active (19)	❍	❍	❍	❍	❍
Afraid (20)	❍	❍	❍	❍	❍

Eating Disorder Examination Questionnaire

Q1. Over the past 28 days, how many times have you eaten what most people would regard as an unusually large amount of food (given the circumstances)?

Q2. On how many of these times did you have a sense of having lost control over your eating (at the time that you were eating)?

Q3. Over the past 28 days, on how many days have such episodes of overeating occurred (i.e., you have eaten an unusually large amount of food and have had a sense of loss of control at the time)?

Q4. Over the past 28 days, how many times have you made yourself sick (vomit) as a means of controlling your shape or weight?

Q5. Over the past four weeks, how many times have you taken laxatives as a means of controlling your shape or weight?

Q6. Over the past four weeks, how many times have you exercised in a "driven" or "compulsive" way as a means of controlling your weight, shape or amount of fat, or to burn off calories?

Hunger

How much do you agree with the following statements?

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
I feel hungry most of the time. (1)	❍	❍	❍	❍	❍	❍	❍
Even when I am hungry, I don't allow myself to eat. (2)	❍	❍	❍	❍	❍	❍	❍
I will go long periods of time without eating, even though I feel hungry. (3)	❍	❍	❍	❍	❍	❍	❍
I often get so hungry I feel like I could eat just about anything. (4)	❍	❍	❍	❍	❍	❍	❍
I avoid eating when I am hungry. (5)	❍	❍	❍	❍	❍	❍	❍

Deprivation

How much do you agree with the following statements?

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
There are many foods I do not allow myself to eat. (1)	❍	❍	❍	❍	❍	❍	❍
I wish I could eat foods that other people eat. (2)	❍	❍	❍	❍	❍	❍	❍
I feel that it's not fair that some people can eat any foods they want. (3)	❍	❍	❍	❍	❍	❍	❍
I often feel deprived of my favorite foods. (4)	❍	❍	❍	❍	❍	❍	❍

Cravings

How much do you agree with the following statements?

	Strongly Disagree (1)	Disagree (2)	Somewhat Disagree (3)	Neither Agree nor Disagree (4)	Somewhat Agree (5)	Agree (6)	Strongly Agree (7)
If I eat what I am craving, I often lose control and eat too much. (1)	❍	❍	❍	❍	❍	❍	❍
If I give in to a food craving, all control is lost. (2)	❍	❍	❍	❍	❍	❍	❍
Whenever I have a food craving, I keep on thinking about eating until I actually eat the food. (3)	❍	❍	❍	❍	❍	❍	❍
If I am craving something, thoughts of eating it consume me. (4)	❍	❍	❍	❍	❍	❍	❍

Godin Leisure-Time Exercise Questionnaire

During a typical 7-day period (a week), how many times on the average do you do the following kinds of exercise for more than 15 minutes during your free time? (write the appropriate number)

	Times per week (1)
STRENUOUS EXERCISE (Heart Beats Rapidly; e.g., running, jogging, hockey, football, soccer, squash, basketball, cross country skiing, judo, roller skating, vigorous swimming, vigorous long distance bicycling) (1)	
MODERATE EXERCISE (Not exhausting; e.g., fast walking, baseball, tennis, easy bicycling, volleyball, badminton, easy swimming, alpine skiing, popular and folk dancing) (2)	
MILD EXERCISE (minimal effort; e.g., yoga, archery, fishing from river bank, bowling, horseshoes, golf, snowmobiling, easy walking) (3)	

During a typical 7-day period (week), in your leisure time, how often do you engage in any regular activity long enough to work up a sweat (heart beats rapidly)?

- ❍ Never (1)
- ❍ Rarely (2)
- ❍ Sometimes (3)
- ❍ Often (4)

International Physical Activity Questionnaire (Sedentary items)

The next questions are about the time you spent sitting during the last 7 days. Include time spent at work, at home, while doing course work, and during leisure time. This may include time spent sitting at a desk, visiting friends, reading, or sitting or lying down to watch television.

During the last 7 days, how much time did you spend sitting on a week day?
Hours per day (1)
Minutes per day (2)

During the last 7 days, how much time did you spend sitting on a weekend day?
Hours per day (1)
Minutes per day (2)

Additional Health Questions:

To what degree do you agree with this statement: My diet is healthy.
- ❍ Strongly Disagree (1)
- ❍ Disagree (2)
- ❍ Somewhat Disagree (3)
- ❍ Neither Agree nor Disagree (4)
- ❍ Somewhat Agree (5)
- ❍ Agree (6)
- ❍ Strongly Agree (7)

How would you describe your current health status?
- ❍ Poor (1)
- ❍ Fair (2)
- ❍ Good (3)
- ❍ Very Good (4)
- ❍ Excellent (5)

How many days in the past week did you eat breakfast? _____

How often do you eat in-between your regular meals?
- ❍ Almost every day (1)
- ❍ Sometimes (2)
- ❍ Once in a while (3)
- ❍ Rarely or never (4)

During the past month, how often did you eat fruit? Include fresh, frozen, or canned fruit. Do not include juices.
- ❍ 1 time per week or less (1)
- ❍ Not every day, but more than once per week (2)
- ❍ 1 time per day (3)
- ❍ 2 times per day (4)
- ❍ 3 or more times per day (5)

During the past month, how often did you eat vegetables (do not include french fries)?
- ❍ 1 time per week or less (1)
- ❍ Not every day, but more than once per week (2)
- ❍ 1 time per day (3)
- ❍ 2 times per day (4)
- ❍ 3 or more times per day (5)

Have you ever been diagnosed with an eating disorder?
- ❍ No (1)
- ❍ Yes (please describe) (2) _____

How many hours of sleep do you usually get at night?
- ❍ < 5 hours (1)
- ❍ 6 hours (2)
- ❍ 7 hours (3)
- ❍ 8 hours (4)
- ❍ > 9 hours (5)

Which of the following best describes your smoking habits?
- ❍ I do not smoke (1)
- ❍ Less than one time per week (2)
- ❍ Less than 1 pack per week (3)
- ❍ Less than 1 pack per day (4)
- ❍ About 1 pack per day (5)
- ❍ More than 1 pack per day (6)

Are you currently taking oral contraceptives or using another form of hormonal birth control?
- ❍ Yes (1)
- ❍ No (2)

Are you taking either of the following courses Fall semester?
- ❑ Human Nutrition (1)
- ❑ Health and Wellness Strategies for Life (2)

The following 3 questions ask about your alcohol consumption over the past 30 days. Your responses will be kept confidential. If you prefer not to answer these questions, you may leave them blank.

During the past 30 days, how many days did you have at least one drink of any alcoholic beverage such as beer, wine, a malt beverage, or liquor? _____

Please use this definition: One drink is equivalent to a 12-ounce beer, a 5-ounce glass of wine, or a drink with one shot of liquor.

During the past 30 days, on the days when you drank, about how many drinks did you drink on average? Note: A 40-ounce beer would count as 3 drinks, or a cocktail drink with 2 shots would count as 2 drinks. _____

Considering all types of alcoholic beverages, how many times during the past 30 days did you have 4 or more drinks on an occasion? _____

APPENDIX E: PROGRAM EVALUATION

		1-7 (Extremely Dissatisfied-(Extremely Satisfied)		
		M (SD)	**Min.**	**Max.**
What is your overall satisfaction rating for the intervention you received?	AAT	6.17 (0.58)	5	7
	NE	5.80 (0.42)	5	6
What is your satisfaction rating for your group leader and other study staff?				
Approachable	AAT	6.25 (1.14)	3	7
	NE	6.30 (0.48)	6	7
Helpful	AAT	6.50 (0.52)	6	7
	NE	6.40 (0.52)	6	7
Knowledgeable	AAT	6.50 (0.52)	6	7
	NE	6.70 (0.48)	6	7
Overall Quality	AAT	6.33 (0.78)	5	7
	NE	6.20 (0.92)	4	7
		1-7 (Very Unacceptable-Very Acceptable)		
		M (SD)	**Min.**	**Max.**
How acceptable was the monitoring you were asked to complete (i.e., recording food, recording appetite)?	AAT	6.58 (0.67)	5	7
	NE	5.40 (1.35)	3	7
How acceptable was the length/duration of the intervention?	AAT	6.42 (0.67)	5	7
	NE	5.90 (0.99)	4	7
		1-7 (Disagree-Agree)		
		M (SD)	**Min.**	**Max.**
I fully completed the self-monitoring logs.	AAT	6.67 (0.49)	6	7
	NE	5.80 (0.63)	5	7
I fully completed other tasks asked of me.	AAT	6.50 (0.52)	6	7
	NE	6.00 (0.47)	5	7
		1-7 (Not At All-Extremely)		
		M (SD)	**Min.**	**Max.**
To what extent do you feel the intervention has helped you eat in ways that will prevent weight gain?	AAT	5.58 (0.90)	4	7
	NE	5.40 (1.08)	3	7
		M (SD)	**Min.**	**Max.**
Did anything confuse you about the material presented?	AAT	100% (No)	1	1
	NE	100% (No)	1	1
Did you find anything about the intervention harmful?	AAT	100% (No)	1	1
	NE	100% (No)	1	1
Would you recommend this program to a friend with similar concerns?	AAT	100% (Yes)	2	2
	NE	100% (Yes)	2	2

APPENDIX F: Primary Measures Correlation Table

	BMI	IES Phys	IES Perm	IAQ A	MEQ	WELQ NE	WELQ Avail	WELQ PosAct	WELQ
BMI									
IES Phys	-.15								
IES Perm	-.12	-.19							
IAQ A	-.06	-.47**	.27						
MEQ	.05	.38*	-.24	-.54**					
WELQ NE	-.30	.76**	-.09	-.60**	.46**				
WELQ Avail	.09	.36*	-.56**	-.53**	.74**	.42*			
WELQ PosAct	.23	.36*	-.47**	-.43**	.56**	.37*	.79**		
WELQ	.04	.54**	-.32	-.63**	.71**	.70**	.85**	.81**	
WMSE	-.11	.45**	-.23	-.46**	.55**	.50**	.64**	.44**	.63**

Note. BMI=Body Mass Index; IES Phys=Intuitive Eating Scale-Eating for Physical Reasons subscale; IES Perm= Intuitive Eating Scale-Permission to Eat subscale; IAQ A=Interoceptive Awareness Questionnaire-Appetite subscale; MEQ=Mindful Eating Questionnaire; WELQ NE=Weight Efficacy Lifestyle Questionnaire-Negative Emotion subscale; WELQ Avail=Weight Efficacy Lifestyle Questionnaire-Food Available subscale; WELQ PosAct=Weight Efficacy Lifestyle Questionnaire-Positive Activity subscale; WELQ=Weight Efficacy Lifestyle Questionnaire; WMSE=Weight Maintenance Self-Efficacy.

APPENDIX G: Secondary Outcome Results

	AAT *(n=12)*	Nutrition *(n=10)*	Control *(n=12)*			AAT vs. NE	NE vs. NTC	AAT vs. NTC
	M (SD)	*M (SD)*	*M (SD)*	*p*	η^2	η^2	η^2	η^2
IES								
Baseline	3.12 (0.49)	2.95 (0.54)	3.03 (0.52)					
Post	3.29 (0.31)	3.02 (0.59)	3.26 (0.38)					
Change	0.17 (0.42)	0.07 (0.72)	0.24 (0.61)	.81	.01	.01	.02	.01
IAQ E*								
Baseline	2.74 (1.18)	2.53 (1.01)	2.88 (1.12)					
Post	2.80 (0.97)	2.46 (1.03)	2.63 (0.79)					
Change	0.06 (0.47)	-0.07 (1.27)	-0.27 (1.35)	.75	.02	.01	.01	.03
IAQ Total*								
Baseline	2.71 (0.81)	2.54 (0.68)	2.90 (0.85)					
Post	2.71 (0.58)	2.60 (0.94)	2.71 (0.56)					
Change	0.00 (0.31)	0.06 (1.06)	-0.19 (0.88)	.73	.02	.00	.02	.02
WELQ PhyD								
Baseline	7.54 (1.59)	7.50 (1.37)	8.21 (1.90)					
Post	7.75 (1.71)	7.83 (1.71)	7.48 (1.90)					
Change	0.21 (1.19)	0.33 (1.53)	-0.73 (2.03)	.24	.09	.00	.08	.08
IBSS								
Baseline	3.63 (0.95)	3.57 (0.32)	3.44 (0.73)					
Post	3.26 (0.94)	2.95 (0.93)	3.69 (0.38)					
Change	-0.36 (0.60)	-0.55 (0.57)	0.26 (0.74)	.01	.24	.04	.28	.18
BDS								
Baseline	2.58 (0.89)	2.64 (0.48)	2.68 (0.54)					
Post	3.07 (0.90)	2.98 (0.71)	2.88 (0.57)					
Change	0.49 (0.35)	0.34 (0.62)	0.19 (0.70)	.44	.05	.03	.01	.07
PANAS Pos								
Baseline	3.47 (0.66)	3.81 (0.48)	3.74 (0.65)					
Post	3.49 (0.75)	3.37 (0.78)	3.06 (0.62)					
Change	0.03 (0.39)	-0.44 (0.92)	-0.68 (1.02)	.12	.13	.11	.02	.18
PANAS Neg*								
Baseline	2.36 (0.73)	2.23 (0.56)	2.59 (0.82)					
Post	2.33 (0.55)	1.80 (0.62)	2.65 (0.63)					
Change	-0.03 (0.63)	-0.43 (0.70)	0.06 (1.02)	.34	.07	.09	.08	.00
IPAQ*								
Baseline	6.61 (2.51)	5.68 (2.64)	7.88 (3.08)					
Post	9.66 (3.51)	8.83 (3.91)	7.14 (2.14)					
Change	3.04 (3.90)	3.15 (4.09)	-0.74 (3.93)	.04	.20	.00	.20	.20

GLTEQ								
Baseline	47.09 (18.58)	54.45 (29.66)	62.08 (22.74)					
Post	50.18 (29.04)	46.50 (23.98)	59.34 (19.96)					
Change	3.09 (20.77)	-7.95 (22.10)	-2.38 (31.10)	.62	.03	.07	.01	.01

Note. AAT=Appetite Awareness Training; NE= Nutrition Education; NTC=No Treatment Control; IES =Intuitive Eating Scale; IAQ E= Interoceptive Awareness Questionnaire-Emotion subscale; IAQ=Interoceptive Awareness Questionnaire; IBSS=Ideal Body Satisfaction Scale; BDS=Body Dissatisfaction Scale; PANAS Pos=Positive and Negative Affect Scale-Positive Emotion subscale; PANAS Neg=Positive and Negative Affect Scale-Negative Emotion subscale; IPAQ=International Physical Activity Questionnaire; GLTEQ=Godin Leisure Time Exercise Questionnaire. Unadjusted values used for means and standard deviations; Outlier Adjusted values used for p-values and effect sizes.

**=negative change score indicates improvement.*